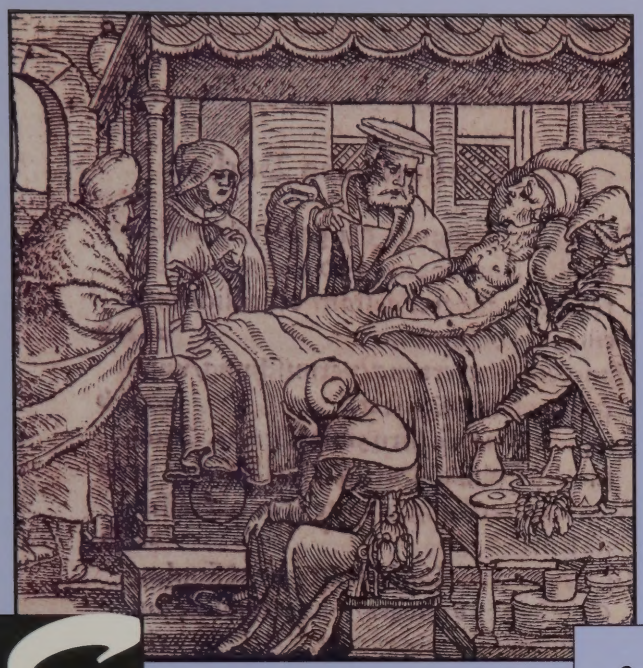

Emotions and Disease

An exhibition at the
National Library of Medicine
National Institutes of Health • Bethesda, Maryland

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November 13, 1996 to May 1, 1997

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An exhibition at the
National Library of Medicine

Exhibition Directors:
Elizabeth Fee
Esther M. Sternberg

Visiting Curators:
Anne Harrington
Theodore M. Brown

Friends of the
National Library of Medicine

Published in conjunction with the exhibition *Emotions and Disease*, organized by the History of Medicine Division, National Library of Medicine

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Cover:

(left) Walther Ryff (d. 1548), *Spiegel und Regiment der Gesundheyt*, Frankfurt, 1555.
Graphic: Photographic reproduction of woodcut illustration.

(right) Rudolf Virchow (1821–1902), *Die Cellularpathologie in ihrer Begründung auf Physiologische und Pathologische Gewebelehre*, Berlin, 1858.

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Exhibition Directors' Statement

The exhibition *Emotions and Disease* was initially developed by the History of Medicine Division of the National Library of Medicine, in conjunction with the Third International Congress of the International Society for Neuroimmunomodulation which met at the National Institutes of Health in November 1996. The exhibition was intended to provide historical perspective and context for the scientific discussions and presentations at the Congress and to explain to the general public the meaning and relevance of scientific developments linking neurophysiology to the functioning of our immune systems. Using the historical approach, we believed we could make these sophisticated scientific developments more accessible to a non-specialist audience. The historical approach could also be used to show the complex relationships between scientific theories, popular ideas, and their cultural context.

One of the paradoxes we found was that the close relationship between health, disease, and the emotions seemed to be more readily accepted in popular culture than within the contemporary scientific community. Why, we asked, has the close relationship of emotions to disease been so central to the long history of medical practice, yet has been regarded with suspicion by some sectors of the modern biomedical community?

This exhibition evolved as a dialogue between scientists and historians pursuing answers to these questions. The dialogue has been fruitful, although difficult at times. The historians involved have had to learn some of the language and perspectives of the biomedical sciences, and the scientists have had to cope with the different language and perspectives of the historians. Working on this exhibition, we found that the collaboration across disciplines, indeed across the great divide between contemporary science and the humanities, can be a rewarding adventure for all participants and well worth the occasional linguistic, philosophical, and political struggles involved. The results appeal to and engage a variety of audiences from students of science and history to professionals in these fields.

We would like to thank Dr. Sheldon Cohen, himself a model of interdisciplinary work between the history of medicine and contemporary science, for introducing us: Elizabeth Fee, a historian of medicine, and Esther Sternberg, a neuroendocrinimmunologist. Together we developed the general outline of the exhibition and invited Anne Harrington and Theodore M. Brown to serve as visiting curators, responsible for the overall intellectual development of the exhibition and for writing the panels, captions, and catalogue materials. Gretchen Hermes joined us for a summer as assistant curator. Key to the success of the exhibition were our panel of distinguished consultants and the timely and generous support of the Charles A. Dana Foundation, the John D. and Catherine T. MacArthur Foundation, the Fetzer Institute, and the National Institute of Mental Health. Also essential were the invaluable contributions of Lou Storey as exhibition designer, Anne Whitaker as collections manager, and Patricia Tuohy as exhibition manager. The acknowledgments in this catalogue recognize the many individuals who contributed to this project and to whom we are grateful.

The talented people involved in the creation of this exhibition have worked together to show how historical research and contemporary science, presented through creative use of visual design and modern media, can be effective in bringing new forms of scientific understanding to the public. We believe that the history of science and medicine can help us understand and appreciate the frontiers of science while also demonstrating the ways in which our forebears have addressed, explored, and puzzled over the same issues that engage us today. By addressing past and current controversies in science and medicine, we hope to captivate public interest and help build awareness of the need for further historical and medical research. As in the case of *Emotions and Disease*, federal agencies and private foundations can work together to produce attractive and instructive educational materials on health and medicine for the public. We hope this project may serve as an inspiration and model for many other such efforts.

Elizabeth Fee, Ph.D.
Chief, History of Medicine Division
National Library of Medicine

Esther M. Sternberg, M.D.
Chief, Section on Neuroendocrine Immunology and Behavior
National Institute of Mental Health

Woodcut from Walther Ryff (d. 1548), **Spiegel und Regiment der Gesundheyt,** Frankfurt, 1555

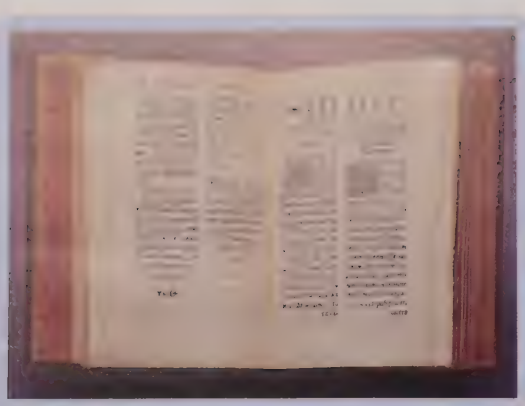
In this bedside scene in a traditional medical setting, the physician is in close contact with the patient, taking the pulse and in easy visual and verbal range.

Emotions and Disease in Historical Perspective

Theodore M. Brown

In the world today, science is about to validate long-held beliefs about the relationship between emotions and disease. A new field of research, exploring the connections between the neuroendocrine and immune systems, has already produced exciting discoveries which promise to confirm, in the most modern scientific terms, the influence of emotions on the onset, course, and remission of disease. For centuries and long before the first glimmerings of modern science, physicians and non-physicians alike have acknowledged that the way people felt in their minds could influence the way they responded in their bodies. When prevailing medical theory denied the very possibility of such interactions, common experience and sometimes quite startling clinical encounters suggested otherwise. The relationship between emotions and disease has often been like a haunting melody that could not be forgotten, while it has sometimes surged into full chorus.

It has been this way ever since the beginning of the Western scientific tradition. Although the specific terms of discussion have changed many times in the course of history and even though medicine has been transformed several times in the process, perceptive observers have regularly returned to the study of the interactions of body, mind and medicine. These interactions have continued to fascinate, even though they have never been completely understood. At times when the majority of physicians and scientists focused attention elsewhere, a minority refused to let the issues die. Now the issues are back again, front and center, in the convergent focus of the lay public, clinical medicine, and modern laboratory science. This exhibition highlights significant achievements and major turning points on a well-traveled historical road which is taking a turn yet again as it leads into the promising but indefinite future.



Hippocrates, **Hippokratous . . . Iatrike,** Basel, 1543

This is a Renaissance edition of works by Hippocrates, with parallel text in Greek and Latin.

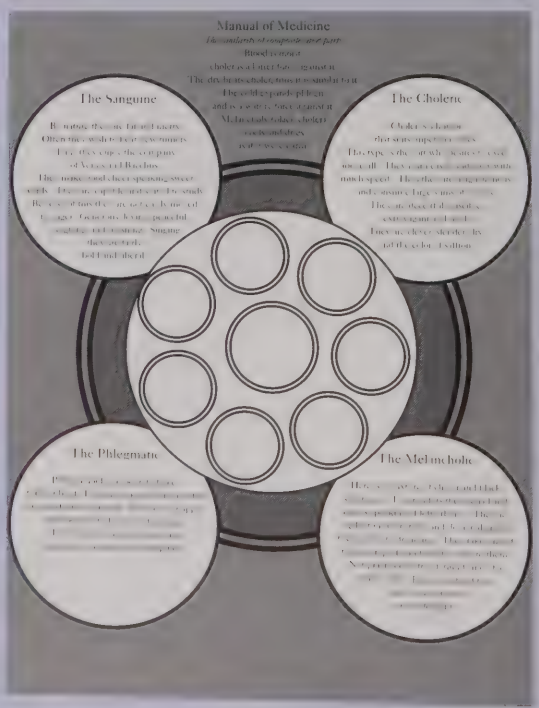
The Balance of Passions

This story begins, as did so many other components of our culture, in Greek and Roman antiquity where medicine first emerged as a secular activity independent of religion. There Hippocrates (ca. 460 B.C.–ca. 370 B.C.) and his followers combined naturalistic craft knowledge with ancient science and philosophy to produce the first systematic explanations of the behavior of the human body in health and illness. Distant ancestors of modern biomedical scientists began to explore the solid and fluid parts of the human organism for keys to unlock the hidden mechanisms of disease. They made the first attempts to understand emotions as mental phenomena which had surprising and complex connections to physiological order and pathological disorder.

Early Western physicians recognized that emotions were of essential significance, however, their medical systems were actually weighted more heavily on the body side of the mind-body balance. The dominant theory of Hippocrates and his successors was that of the four "humors": black bile, yellow bile, phlegm, and blood. When these humors were in balance, health prevailed; when they were out of balance or vitiated in some way, disease took over. The goal of an individual's personal hygiene was to keep the humors in balance, and the goal of medical therapy was to restore humoral equilibrium by adjusting diet, exercise, and the management of the body's evacuations (e.g.: the blood, urine, feces, perspira-

Johannes de Ketham (fl. 1455–1470), **Fasciculus Medicinae,** Vienna, 1495

Johannes de Ketham, a professor of medicine in Vienna, published **Fasciculus Medicinae,** *which included illustrations on bloodletting and urine flasks showing the "resemblance of the elements and the bodily constitutions." This is an English translation of Latin text.*



tion, etc.).[1] The bedside scene from Walther Ryff's *Spiegel und Regiment* and the diagram from Johannes de Ketham's *Fasciculus Medicinae*, although both from later periods, clearly illustrate these classical themes.

Emphasizing the humors gave classical medicine what modern philosophers call a "reductionist" bias—the humors were used to explain more complex phenomena like emotional states in much simpler physical terms. For example, when a patient was melancholy, physicians assumed that his or her complicated feelings of sadness and depression resulted from the physical excess of black bile. Likewise, an excess of yellow bile was thought to make a person angry and impulsive. In the Hippocratic treatise *The Sacred Disease*, the author explains that "those maddened through bile are noisy, evil-doers and restless, always doing something inopportune"[2]; this explanation assumes that emotions are the more complicated *consequences* of the simpler and prior humoral *causes*.

Even in the unmistakably reductionist Hippocratic writings, however, certain emotional states appear as causal elements. In one case, a woman began to exhibit fears, depression, incoherent rambling speech, and the uttering of obscenities after suffering from a "grief with a reason for it"; and another "without speaking a word . . . would fumble, pluck, scratch, pick hairs, weep and then laugh, but . . . not speak," also "after a grief."[3] In *The Sacred Disease*, epilepsy is said in certain circumstances to be "caused by fear of the mysterious."[4]

Emotional factors played only a minor role in the subsequent development of classical medical thought because authors after Hippocrates continued to rely primarily on humoral-reductionism and did not actively pursue emotional causal elements. These medical authorities worked hard to clarify and codify the humoral ideas embedded in Hippocrates's work. They also systematized a therapy based on "opposition," whereby excess humors were depleted and "cold" medicines such as oil of roses countered "hot" diseases like fevers and vice versa. Some writers in late antiquity also added important anatomical features to their reductionist medical systems.[5]

But another dimension to medical thought became increasingly prominent in later antiquity. This was the orientation towards emotions as causes, which was strongly influenced by Galen (A.D. 131–201). Known for his prolific writings and essential loyalty to humoralism, he was accepted in the medieval and Renaissance periods as coequal with or even superior to Hippocrates. Deeply respected for his diagnostic skill, Galen was celebrated for his differential diagnoses, especially for those which distinguished between illnesses traceable to organic causes and those which seemed to mimic them but were actually traceable to emotional causes

Justus Cortnummius (ca. 1624–1675), **De Morbo Attonito Liber Unus,** Leipzig, 1677

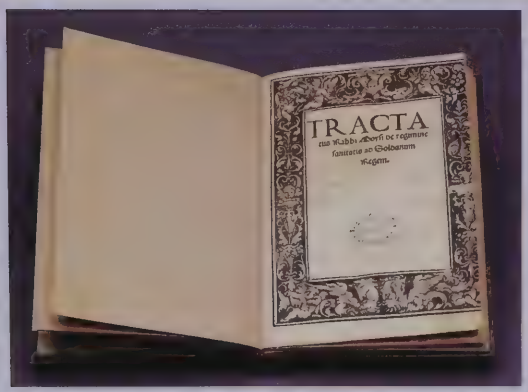
For much of the medieval and Renaissance periods, Galen and Hippocrates were regarded as coequal medical authorities, with Galen even assuming a superior position for certain medical teachers or commentators. In the seventeenth century, however, the more empirically oriented Hippocrates came to be regarded as superior to the more theoretical Galen. This distinction between the two men is depicted here on the title page by Hippocrates touching the rose-bush on the side of the flowers and Galen touching the side of the thorns.

Galen, **Opera ex Sexta Juntarum Editione,** Venice, 1586

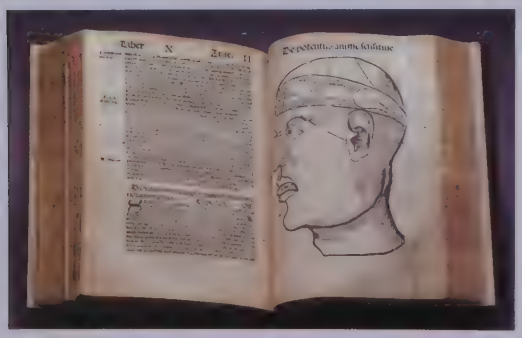
Galen is making a diagnosis of love-sickness.

. . . I came to the conclusion that she was suffering from one of two things: either from a melancholy dependent on black bile, or else trouble about something she was unwilling to confess.

Galen
As quoted in *Galen—On Mental Disorders*, Stanley W. Jackson



Maimonides (1135–1204), **Tractatus Rabbi Moysi de Regimine Sanitatis ad Soldanum Regem,** Augsburg, 1518



Gregor Reisch (d. 1525), **Margarita Philosophica cum Additionibus Novis,** Basel, 1517

Gregor Reisch included an often-reproduced woodcut profile of the head in his book **Margarita Philosophica.** The figure locates various faculties of the soul (cogitation, memory, etc.) in specific regions. Note that Imaginativa (imagination) is located directly over the eyes.

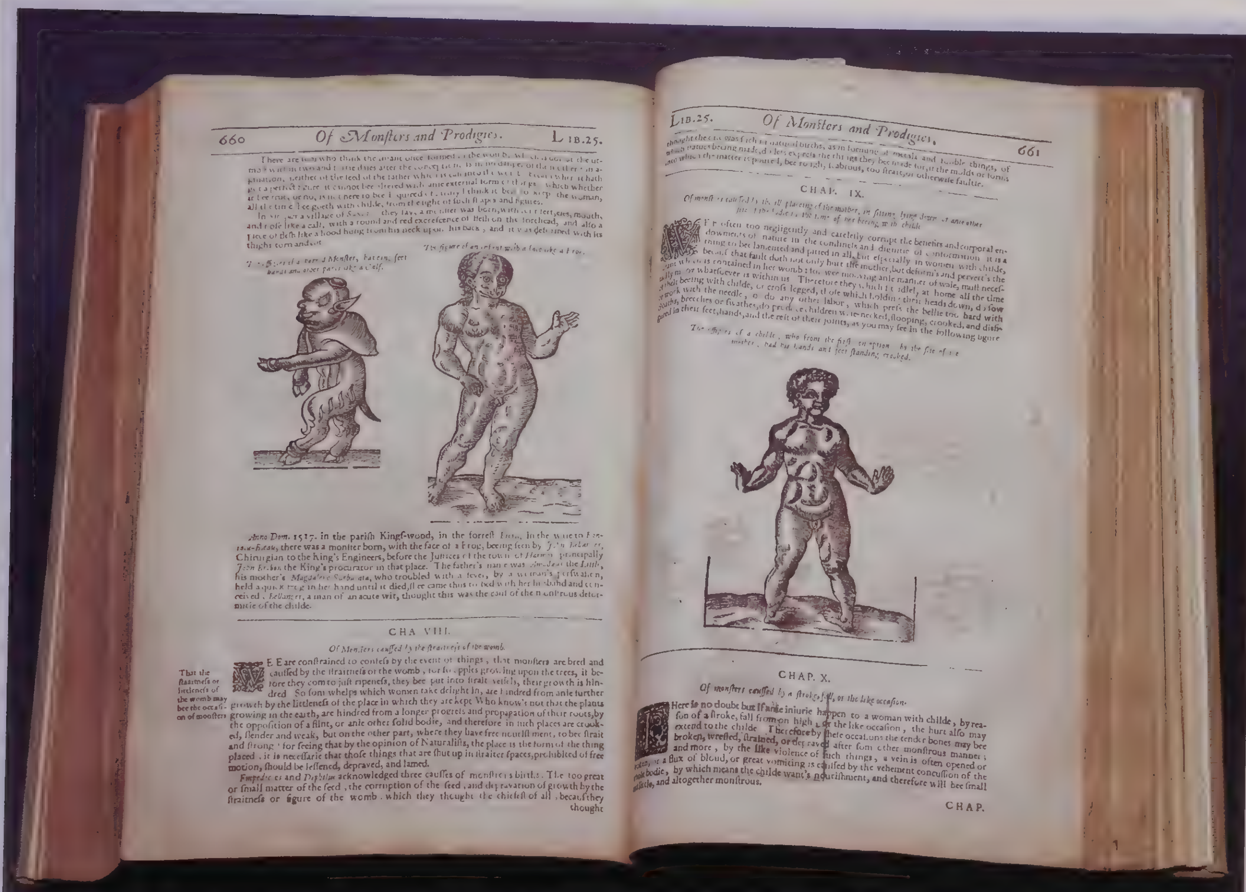
instead. In one famous case he treated a young woman who seemed to exhibit the signs of physical illness but who, upon closer examination, revealed no organic pathology. After eliminating any possible humoral explanation, Galen identified the real, emotional cause of her somatic symptoms: a hidden love interest.[6] He used the sudden irregularity of her pulse as a crucial diagnostic clue.

Galen likewise contributed an important new interest in the balance not only of the humors but of what he called the "non-naturals," among which he included the "passions or perturbations of the soul."[7] According to the doctrine of the non-naturals—which was incorporated in medieval medical books alongside the humors—it was important for physicians to help patients keep their emotions in balance, for the sake of their bodies as well as their mental states. The influence of strong emotions on physical health and illness thus became a central tenet of medical belief which grew progressively stronger in the medieval period. As rabbi, philosopher and physician Moses Maimonides expressed the point in the twelfth century, "It is known . . . that passions of the psyche produce changes in the body that are great, evident and manifest to all. On this account . . . the movements of the psyche . . . should be kept in balance . . . and no other regimen should be given precedence."[8]

Ideas about the "balance of the passions" were popular in the Renaissance and early modern periods. One famous work showing how influential these ideas would become is Robert Burton's *The Anatomy of Melancholy* which included the following observations about the possibly disastrous role of unchecked emotions: "the mind most effectually works upon the body, producing by his passions and perturbations miraculous alterations . . . cruel diseases and sometimes death itself."[9] Also in this period, speculation about the role of the "imagination" added other elements to the non-physical causes of disease. Some authors suggested that the imagination affected the body directly by its immaterial agency, others that it operated indirectly by first arousing the emotions which, in turn, "are greatly alterative with respect to the

The physician should make every effort that all the sick, and all the healthy, should be most cheerful of soul at all times, and that they should be relieved of the passions of the psyche that cause anxiety.

Moses Maimonides (1135–1204)
The Regimen of Health



Ambroise Paré (1510?–1590), **The Workes,** London, 1649

Speculation about the influence of the "imagination" was intense during the Renaissance period. It was widely believed that vivid ideas could lead to various bodily consequences, including diseases and monstrous births. Paré, a famous early surgeon, reported on two cases, one of a child born with the body of a calf, and another that occurred in 1517, of a child "born having the face of a frog," produced by the power of the mother's imagination. The mother, advised by her neighbor to hold a live frog in her hand as a means to cure her fever, was still holding the frog that evening, when she and her husband conceived a child.

William Falconer (1744–1824), **A Dissertation on the Influence of the Passions Upon the Disorders of the Body,** London, 1788

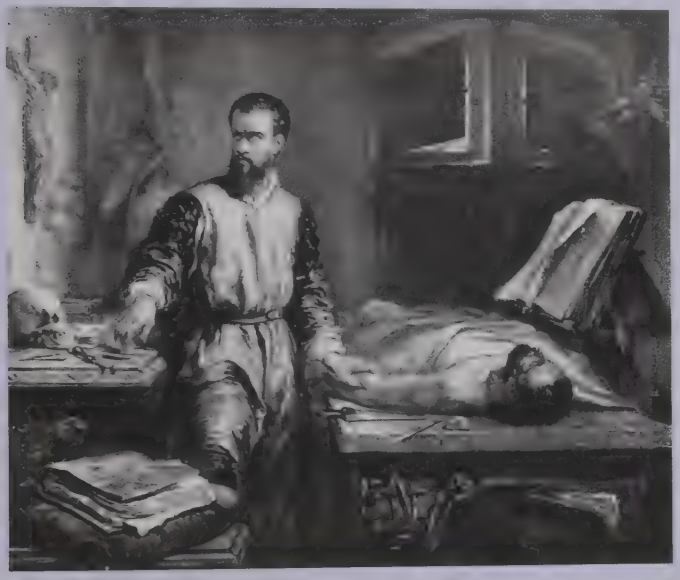
body."[10] There was general agreement that emotionally-charged ideas could exert enormous effects, as in the case of the monstrous "frog baby" produced by vivid maternal imagination, reported by Paré.

Intellectuals and lay people alike were strongly committed to these ideas in the seventeenth and eighteenth centuries. While certain philosophical fashions within the medical community changed to reflect the Scientific Revolution going on around it, much medical practice remained traditional and fundamentally unaltered. Consideration of the role of the imagination and of strong emotions in the onset and course of illnesses continued into the nineteenth century. Medical literature included extensive essays and specialized monographs on emotional states and their impact on somatic health and disease.[11] One example is William Falconer's *A Dissertation on the Influence of the Passions Upon the Disorders of the Body.*

Bobonne, Bobonne, tu me ferais un monstre comme ça, ne le regarde pas tant!, Honoré Daumier (1808–1879)

The husband is attempting to lead his pregnant wife away from the cage of the great apes at the zoo. He is afraid that by looking at the ape in her condition, she might give birth to a deformed baby. The longstanding belief that the vividly stimulated imagination of pregnant women could lead to "monstrous" births persisted in popular culture well into the nineteenth century.

In many ways, however, the close of the eighteenth century marked a new era. As part of the Scientific Revolution, anatomical investigation once undertaken in antiquity had revived and became a hotly pursued field of study. Andreas Vesalius in sixteenth century Padua and Thomas Willis in seventeenth century Oxford were just two of the many bold explorers who cut into the body, probed its structure, and displayed their findings in beautifully illustrated works. In the eighteenth century, physicians increasingly turned to anatomy as a foundation for pathology. As a result, disease processes were progressively "localized," that is, said to reside primarily in the disruptions or "lesions" of the solid

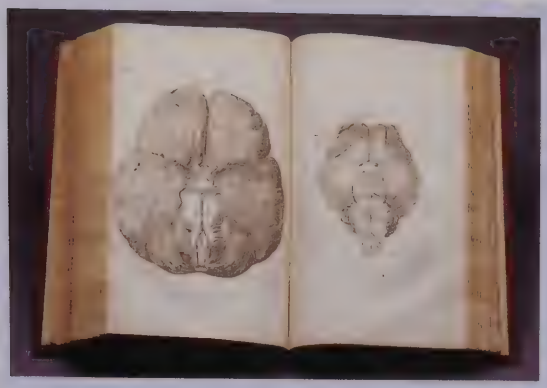


Andreas Vesalius
Edouard Hamman (1819–1888)

What is particularly notable about this scene of Vesalius about to perform an autopsy is his gaze, directed away from the cadaver, and his hand resting on the left arm, almost as if taking a pulse. Like the Chartran portrayal of Laënnec, this nineteenth century image strongly conveys the anatomical basis of the new medicine.

Illustration of dissecting instruments from Andreas Vesalius's **De Humani Corporis Fabrica.** The **De Fabrica,** the first modern work of anatomy, was initially published in 1543. This plate is from the 1568 Venice edition.

Andreas Vesalius (1514–1564), **De Humani Corporis Fabrica,** Venice, 1568



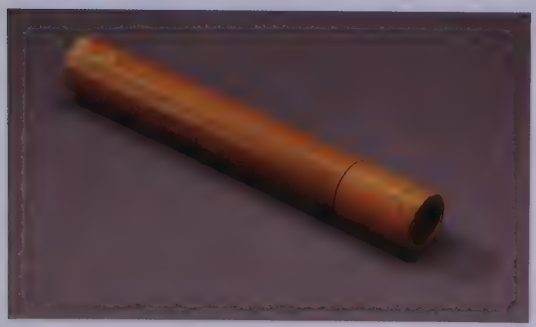
Thomas Willis (1621–1675), **The Remaining Medical Works of Thomas Willis,** London, 1679

An outstanding example of seventeenth-century anatomical achievement was Thomas Willis's **Cerebri Anatome (On the Anatomy of the Brain),** first published in 1664. Shown here are Willis's engravings of the human brain (left page) and of the sheep brain (right page).

parts of the body rather than in the imbalance of humors. Post mortem dissection became an increasingly common medical practice.[12]

At the turn of the nineteenth century, diagnostic breakthroughs swiftly succeeded the maturation of gross pathological anatomy. R.T.H. Laënnec invented a primitive stethoscope (he called it a "cylinder") to help him hear inside his patient's body and thus imagine what the parts "looked" like because of the particular sounds they elicited. In the process of concentrating their attention on the anatomical abnormalities of the solid parts of the body during an illness and as a result of disease, Laënnec and other physicians of his time gained precision in their diagnoses but began to lose the immediacy and intimacy of verbal contact with their patients.[13] Clearly captured in Chartran's painting of Laënnec performing a physical examination is the growing communication gap between doctor and patient, each seemingly contained in his own separate world. This stands in sharp contrast to the scene typically depicted at the medieval bedside.

The further development of microscopic anatomy by Rudolf Virchow and others in the nineteenth century led to

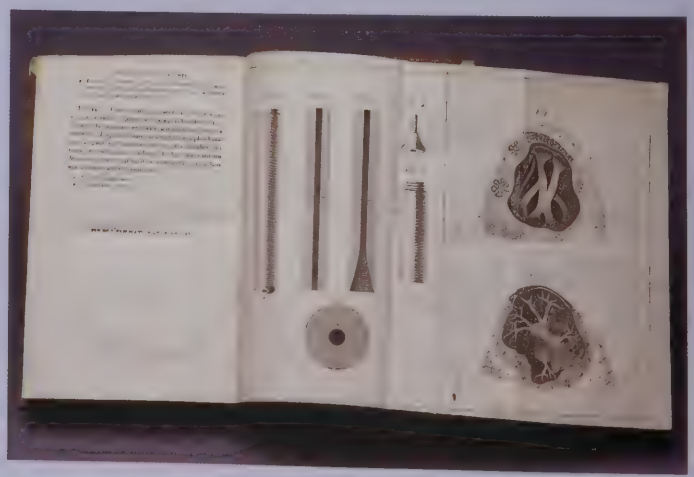


Laënnec-style Stethoscope

In 1819, Laënnec first described his powerful new diagnostic invention, the cylinder-like stethoscope. The physician placed one end of the instrument on the patient's chest and his ear to the other, so he could listen to the sounds of disrupted anatomy within.

Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C.

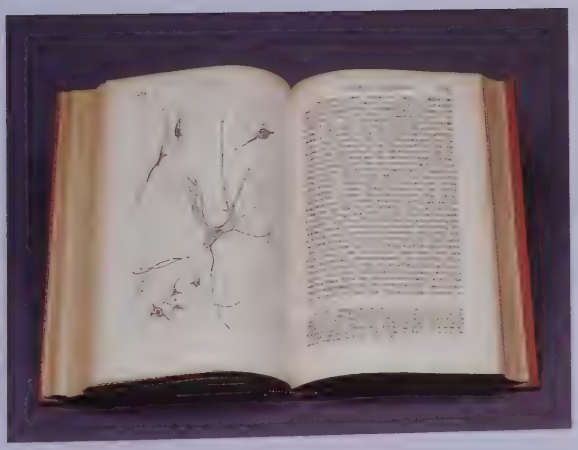
Laënnec, A l'Hopital Necker, Ausculte Un Phtisique
Thérèse Chartran (1849–1937)



René Théophile Hyacinthe Laënnec (1781–1826), **De l'Auscultation Médiate, ou, Traité du Diagnostic des Maladies des Poumons et du Coeur (On Mediate Auscultation, or, Treatise on the Diagnosis of the Diseases of the Lungs and Heart),** Paris, 1819

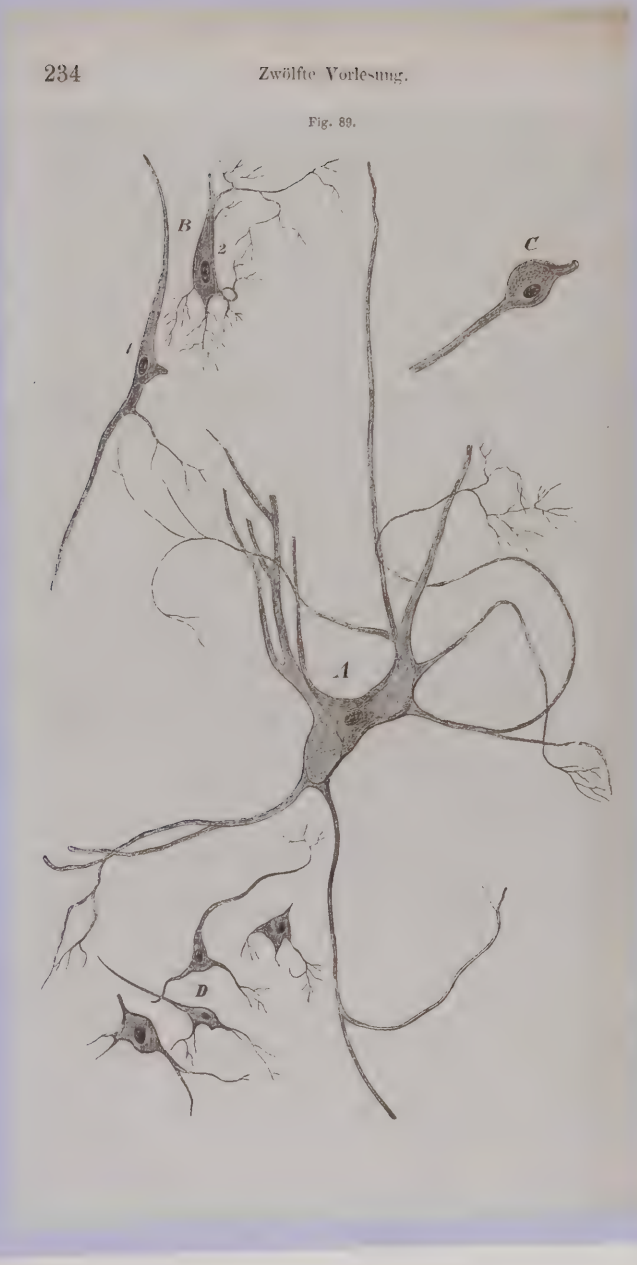
The stethoscope is illustrated here in a fold-out plate with parts of the lung shown at the right.

Rudolph Virchow (1821–1902) is regarded as perhaps the greatest medical scientist of the nineteenth century. He was a pioneer in the field of cellular pathology and pursued pathological anatomy at the tissue and cell level.



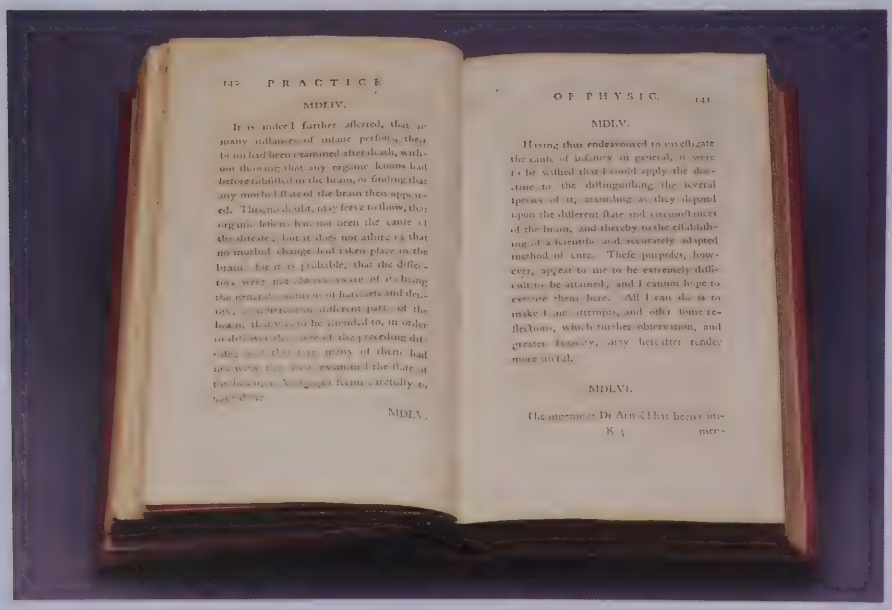
Rudolf Virchow, **Die Cellularpathologie in ihrer Begründung auf Physiologische und Pathologische Gewebelehre,** Berlin, 1858

In Virchow's most influential book, **Die Cellularpathologie,** he described and depicted the precise microscopic structure of cells—including nerve cells—but seemed to leave no place in the body's operation for the influence of the emotions.



greater knowledge of tissues and cells. This development, unfortunately, also fragmented the notion of organismic unity implicit in classical and early modern medical theory.[14] Emotions became more and more separated from disease.

By the mid-nineteenth century, however, a place was secured for emotions in connection with disease even as postmortem anatomy and cellular pathology advanced. Already in the eighteenth century William Cullen had noted that patients with certain major disorders—"insanity," for example—did not always show the expected organic lesions upon postmortem dissection. He reasoned that, instead, such patients may have developed "a considerable and unusual excess in the excitement of the brain" and that this excitement could in turn have derived from "violent emotions or passions of the mind."[15] Cullen and Robert Whytt were two

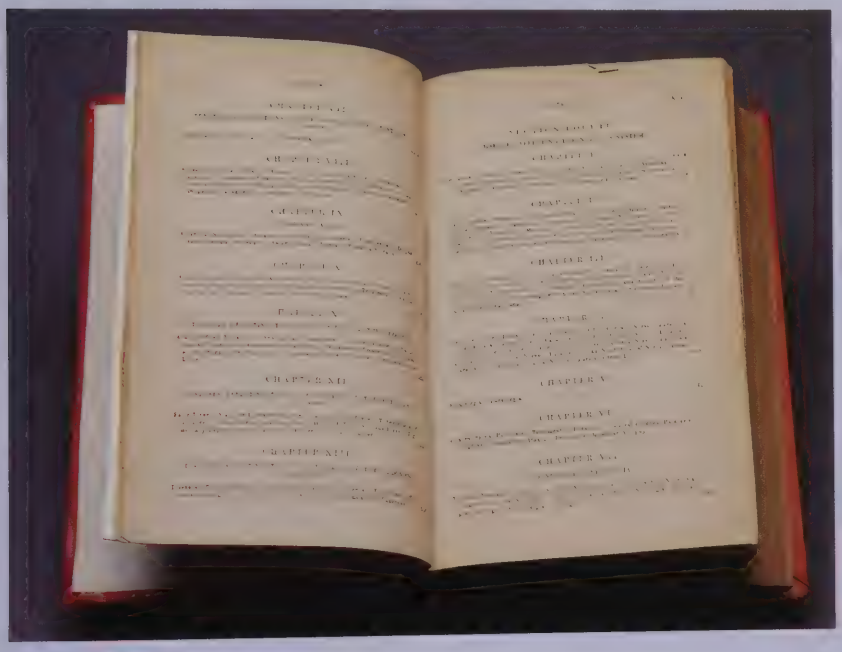


William Cullen (1710–1790), **First Lines of the Practice of Physic,** Edinburgh, 1784

. . . in many instances of insane persons, their brain had been examined after death, without showing that any organic lesions had before subsisted in the brain, or finding that any morbid state of the brain then appeared.

William Cullen
First Lines of the Practice of Physic, 1784

of the many physicians who turned to the nervous system to find a physiological connection between emotions and disease. These physicians hoped to find in nervous system physiology a compromise of sorts between traditional ideas linking emotions and disease and the new desire to extend the reach of localistic pathology. Since the nervous system was enormously complex and its functions were subtle and elusive, it *could* be the locus of "functional" disorders, which were characterized by disrupted activity but where no inflammation or "appreciable morbid change in the nervous structure" could be found. By the 1840s and 1850s, functional disorders of the nervous system (also called "neuroses") and the emotional causes that precipitated them had become a major area of clinical study, as is clear in Austin Flint's popular *A Treatise on the Principles and Practice of Medicine.*



Austin Flint (1812–1886), **A Treatise on the Principles and Practice of Medicine,** Philadelphia, 1868

. . . the neuroses are purely functional affections. . . . [They] occur also as symptoms of diseases involving either inflammation or lesions of structure.

Austin Flint
A Treatise on the Principles and Practice of Medicine, 1868

Un Leçon Clinique à la Salpêtrière, 1887
André Brouillet

Jean-Martin Charcot demonstrating in a clinical lecture to his colleagues at the Salpêtrière, a large hospital in Paris, that the symptoms of hysteria were as real as those of any organic disease.

Psychosomatic Medicine: "The Puzzling Leap"

The next major stage in the unfolding of the relationship between emotions and disease began with the deeper exploration of one of the neuroses: hysteria. This complex disorder was long known in medicine but not until the seventeenth and eighteenth centuries was it seriously associated with the nervous system or emotional causation. Until that time it was regarded as of uterine origin, as its name implies (from the Greek "hystera" = uterus).[16] In the seventeenth century, Thomas Willis thought that hysterical disorders were primarily convulsive consequences of "the brain and nervous stock being affected." Famous clinician Thomas Sydenham said that they were caused by "irregular motions of the animal spirits," which were frequently precipitated by "some great commotion of mind, occasioned by some sudden fit, either of anger, grief, terror or like passions." In the eighteenth century, Robert Whytt acknowledged that these disorders may mimic almost any common somatic condition in a "chameleon"-like or "protean" fashion, and may be triggered by intense "imagination," as when a patient falls into convulsive fits upon seeing someone in an epileptic seizure. Because of the extraordinarily varied nature of their symptoms and the suspected role of the emotions, patients suffering from hysteria and related "functional neuroses" were often thought by both physicians and lay people to be experiencing merely "imaginary diseases," as clearly depicted by the artist Honoré Daumier.

In spite of this widespread attitude, by the 1840s and 1850s hysteria was a serious subject in medical textbooks and in separate, often massively detailed studies. One of the most remarkable of these was the 800-page *Traité Clinique et Thérapeutique de l'Hystérie* published in 1859 by Pierre Briquet, which presented data derived from 430 hysterical patients observed at a Paris hospital over a ten-year period.[17] Jean-Martin Charcot, the famous French clinician celebrated for his elucidation of organic neurological syndromes, also turned his attention to hysteria. In the 1870s, Charcot followed Briquet's lead in studying hundreds of hospital patients in an attempt to specify its precise symptomatology and clinical course.[18]

Charcot's goal was to discover regularity and pattern amidst the confusing welter of hysterical symptoms. He wanted to show that despite its often dramatic appearances, hysteria was not merely "protean" but a solid clinical entity with recurrent and universal features, just like the anatomically-based neuropathological conditions he had previously studied. With the help of meticulous, long-term observation and the innovative use of the photographic camera, Charcot deter-

Le malade imaginaire
Honoré Daumier (1808–1879)

Even as some doctors defended the idea of "neuroses"—nervous diseases without apparent organic cause—others remained suspicious. Weren't neurotic disorders better thought of as the imaginary diseases of tiresome patients looking for attention?

Courtesy Penny Herscovitch

Camera, ca. 1900

People said that the camera was as crucial to Charcot's objective study of hysteria as the microscope was to histology.

Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C.

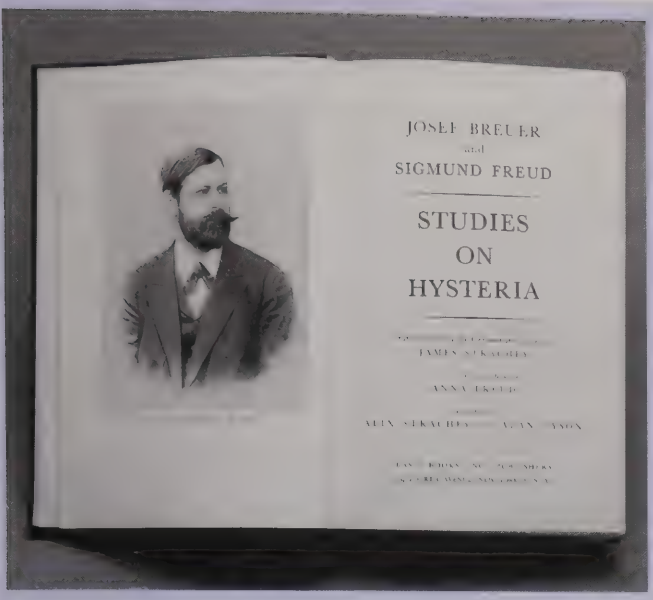
Planche II.

ATTAQUE HYSTÉRO-ÉPILEPTIQUE

LETHARGIE

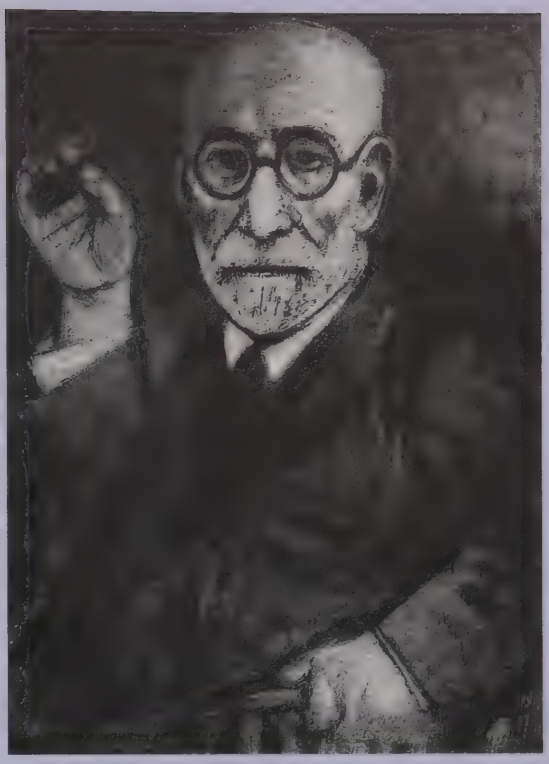
Désiré Magloire Bourneville and Paul Regnard, **Iconographie Photographique de la Salpêtrière,** Paris, 1877–1880

At the Salpêtrière, doctors photographed and catalogued the supposed organic markers of hysteria. Charcot claimed that the resulting record of symptoms was "valid for all countries, all times, all races," and "consequently universal."



Josef Breuer and Sigmund Freud, **Studies on Hysteria,** New York, 1957

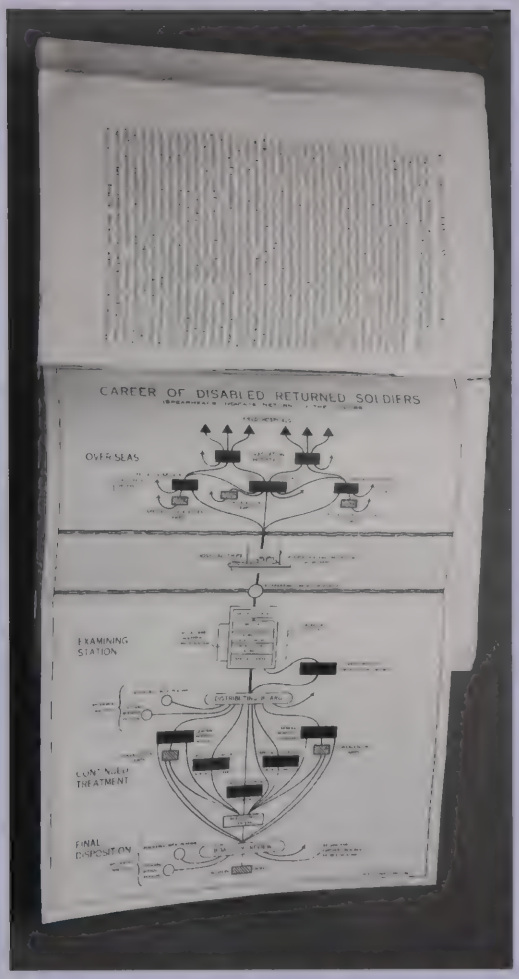
Studies on Hysteria included the famous case study of "Anna O."



Sigmund Freud
Sidney Chafetz

But obsessional neurosis, in which the puzzling leap from the mental to the physical plays no part, has actually, through the efforts of psycho-analysis, become more perspicuous and familiar to us than hysteria, and we have learnt that it displays certain extreme characteristics of the nature of neurosis far more glaringly.

Sigmund Freud
The Standard Edition of the Complete Psychological Works of Sigmund Freud, 1916–1917



Thomas W. Salmon, **The Care and Treatment of Mental Diseases and War Neuroses ("Shell Shock") in the British Army,** War Work Committee of the National Committee for Mental Hygiene, New York, 1917

Courtesy National Mental Health Association

mined and extensively depicted several characteristic and general phases of the hysterical disorder. He insisted that "nothing occurs at random but, on the contrary, all follows certain well-determined rules which are common to cases seen in both hospital and private practice."[19] Later Charcot introduced hypnotism as both an experimental and therapeutic technique to explore other strange phenomena manifested by hysterical patients and also as a potential key to unlocking the underlying neurophysiological and possibly psychogenic, trauma-related mechanisms of the hysterical neurosis.[20]

Young Sigmund Freud studied with Charcot in Paris during the winter of 1885–1886 and was deeply impressed by his ideas. Freud had already been alerted to the bizarre phenomena of hysteria and to the linkages with hypnosis by the Viennese physician Josef Breuer. Breuer had told Freud about a patient ("Anna O.") whose strange hysterical symptoms he treated in 1880–1882 by inducing hypnotic states and systematically leading her back to the onset of each symptom. Once the patient re-experienced the original circumstances with a display of emotion, the corresponding hysterical symptom disappeared. Freud's study with Charcot gave him a theoretical framework to understand what Breuer had told him. When he returned to Vienna, he and Breuer began a close collaboration publishing their joint *Studies on Hysteria* in 1895. They hypothesized that hysterical symptoms derive from undischarged "memories" connected to "psychical traumas." These memories originated when the nervous system was in a special physiological condition or "hypnoid state"; they then remained cut off from consciousness. Hysterical symptoms resulted from the "intrusion of this second state into the somatic innervation," a mind-to-body process Freud and Breuer called "conversion."

Tensions and differences steadily separated Freud from Breuer. Breuer pursued physiological hypotheses and the continued use of hypnotic techniques. Freud moved in the direction of psychological mechanisms and the abandonment of hypnosis. As Freud's ideas further matured, he developed a novel set of theories and techniques that he called "psychoanalysis." He introduced revolutionary theoretical concepts such as "unconscious" mental states and their energetic "repression," the widespread occurrence of infantile sexuality, and the symbolic encoding of psychological meaning in dreams and hysterical symptoms. Freud also stressed the investigative techniques of "free association" and dream interpretation, two methods for overcoming "resistance" and uncovering hidden unconscious wishes without using hypnosis. He thus shifted away from Charcot's observational approach to an even more revolutionary one: he substituted listening to patients for looking at them.

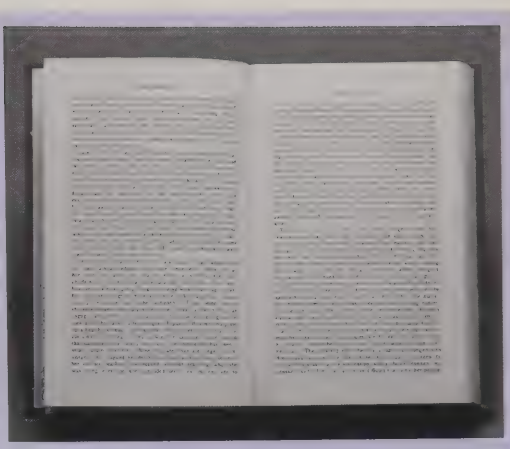
The strong psychogenetic explanation of hysterical symptoms remained a key feature of Freud's mature work and of later psychoanalysis. In his *Introductory Lectures* of

1916–1917, he promoted the notion of conversion as a "puzzling leap from the mental to the physical" and continued to describe hysterical symptoms as symbolic representations of unconscious emotional conflicts. During World War I, Freud's ideas about the emotional origins of hysterical symptoms were often applied to shell-shock and other "war neuroses." Soldiers displaying such somatic symptoms as paralysis, muscular contracture, and loss of sight, speech, and hearing for which no organic bases could be found came to be regarded, as in Thomas Salmon's book, as suffering from conversion hysteria.[21] In these cases, psychogenic explanation focused on unconscious conflicts between "fear" and "duty" with a resulting "flight into illness."

In the 1920s and 1930s conversion hysteria gained popularity as a general medical notion, as psychoanalysts joined internists and other physicians in exploring the meaning of hysterical symptoms. Particularly influential were the Austrian Felix Deutsch, the American Smith Ely Jelliffe, and, most provocatively, the German Georg Groddeck, all physicians and pioneer psychoanalysts.[22] Groddeck was a forceful proponent of the view that the psychological mechanism for hysterical conversion could be generalized to the entire range of somatic disease.[23] He argued in *The Book of the It* that symptoms in *any* organic disorder could be interpreted like hysterical symptoms, as symbolic expressions of unconscious wishes manifested in the patient's body.

The émigré psychoanalyst Franz Alexander tried to work out a compromise between physiology and Freudian theory.[24] Soon after his arrival in the United States from Europe in the early 1930s, he repudiated the approach taken by Groddeck and like-minded analysts. He carefully distinguished between classic conversion hysteria and what he called "organ neuroses," those disturbances of organic function controlled physiologically by the autonomic nervous system (where unconscious symbolic processes are not present). According to Alexander, Groddeck and others had erased a boundary that needed to be carefully redrawn. They had interpreted everything too psychologically and had ignored the automatic physiological mechanisms that substantially controlled the expression of emotion as the body responded to stressful stimuli. But still faithful to the psychoanalytic tradition, Alexander also identified specific unconscious wishes and infantile desires (for example, the unconscious wish to be fed) in the "psychic stimuli" that he said precipitated specific chains of physiological response and, ultimately, specific somatic diseases.

Alexander's theoretical formulations helped stimulate serious psychosomatic research in the United States. He organized a group of investigators from various clinical and laboratory disciplines at the Chicago Institute of Psychoanalysis, and additional research groups soon developed elsewhere. Prominent among these groups was one led by Stanley Cobb



Georg Groddeck (1866–1934), **The Book of the It,** New York, 1928

Groddeck's **Book of the It**—that helped inspire Freud's own concept of the "id"—claimed that all physical illnesses are produced by the unconscious mind.

at the Massachusetts General Hospital.[25] In addition, Helen Flanders Dunbar at the Columbia Presbyterian Medical Center in New York City produced a pioneering monograph, *Emotions and Bodily Changes: A Survey of Literature on Psychosomatic Interrelationships, 1910–1933*, which synthesized recent research findings and in its subtitle gave the growing American movement a name. In 1939, *Psychosomatic Medicine* was founded as the first medical journal devoted specifically to publishing research in this expanding area of investigation.

World War II accelerated the growth of psychosomatic medicine even further. As in World War I, many soldiers displayed the symptoms of shell-shock and its debilitating variants, but during this war the American Armed Forces mobilized psychiatrists and others trained in psychosomatic medicine to help with the problem.[26] Roy R. Grinker's and John P. Spiegel's *War Neuroses in North Africa: The Tunisian Campaign (January–May, 1943)* is an indication of wartime concerns; their expanded edition, *Men Under Stress*, con-

Flanders Dunbar

1902—1959

Psychosomatic Medicine, September–October 1959

Helen Flanders Dunbar (1902–1959). A Dante scholar, theologian and medical doctor, Dunbar hoped psychosomatic medicine would integrate the treatment of spiritual, emotional and physical suffering into a single framework.

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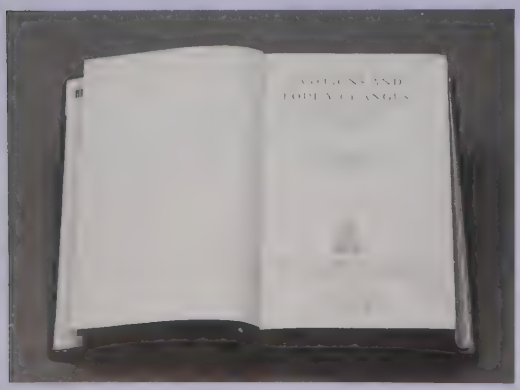
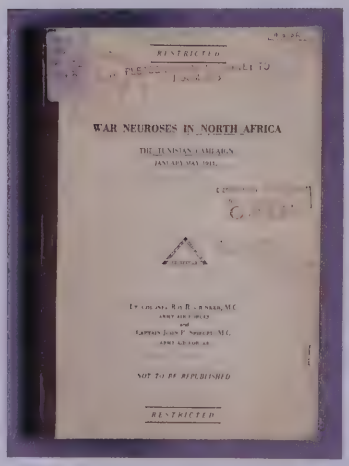


Helen Flanders Dunbar, **Emotions and Bodily Changes: A Survey of Literature on Psychosomatic Interrelationships, 1910–1933,** New York, 1935

Used with permission from Josiah Macy, Jr. Foundation



Roy Grinker and John P. Spiegel, **War Neuroses in North Africa: The Tunisian Campaign (January–May, 1943).** Prepared and distributed for the Air Surgeon, Army Air Forces by the Josiah Macy, Jr. Foundation, New York, September, 1943.

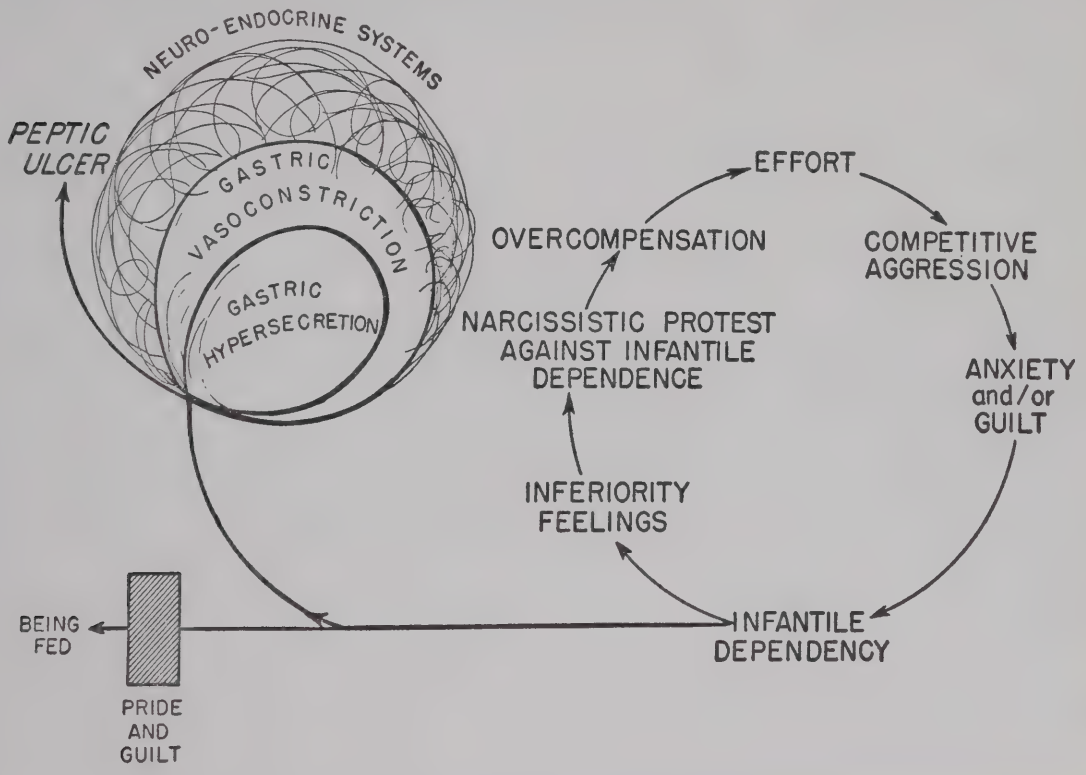
Used with permission from Josiah Macy, Jr. Foundation

Roy R. Grinker and John P. Spiegel, **Men Under Stress,** Philadelphia, 1945

tributed to the heightened postwar enthusiasm for psychosomatic medicine, as did the famous director John Huston's film for the Armed Forces about combat veterans recovering from psychosomatic disorders, *Let There Be Light*. Interest in psychosomatic medicine in the late 1940s and in the 1950s became so intense, in fact, that the scientific literature multiplied rapidly, medical schools created new instructional programs, and textbooks such as Edward Weiss's and Spurgeon English's *Psychosomatic Medicine* found an eager audience among a whole generation of medical students. In addition, Franz Alexander supplemented his numerous professional writings with a popular general text that was as widely read in non-medical as in medical circles and as influential through its diagrams as through its accessible prose. Psychosomatic medicine was so much the "rage" at mid-century that popular magazines ran articles by the score and psychosomatic theories even found their way into the lyrics of a popular Broadway show.

FIGURE III.

Schematic representation of specificity in the etiology of peptic ulcer



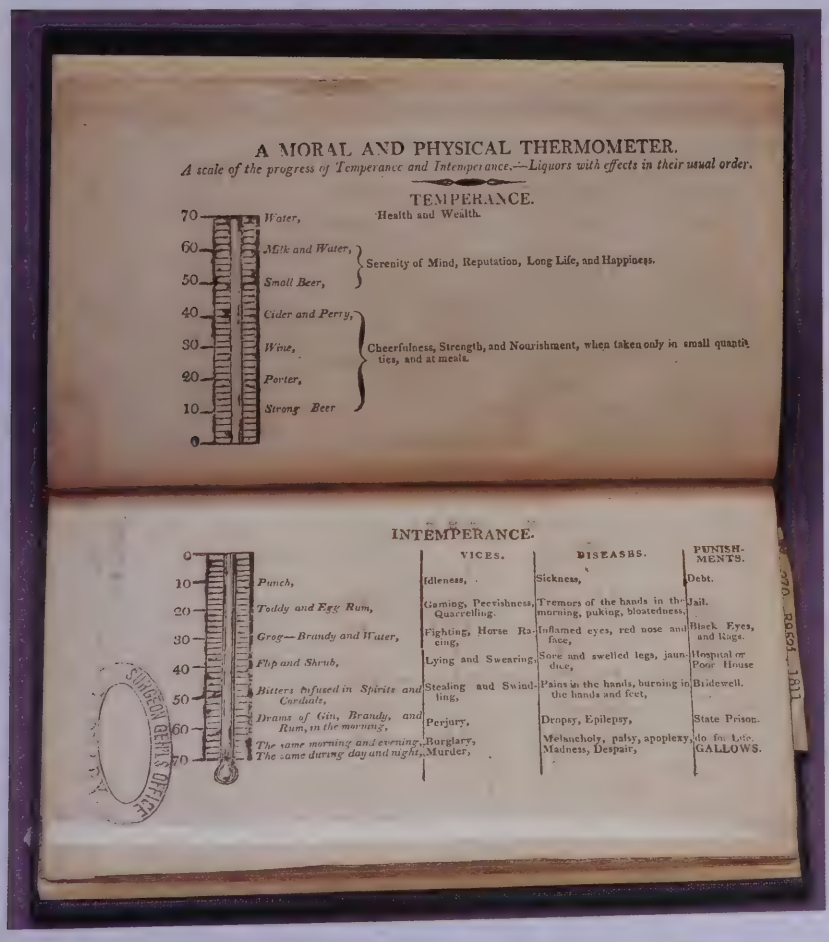
Franz Alexander, **Psychosomatic Medicine,** New York, 1950

Pharmaceutical Era, February 1889

A model pharmacy from the late nineteenth century.

Self-Healing, Patents, and Placebos

However fashionable psychosomatic medicine became, it was by no means the only way Americans pursued their interest in the relationship between emotions and disease. A long-standing tradition of mental self-help, not directed by physicians and concentrating on overt and positive rather than covert and negative feelings, began in the late nineteenth century and was still strong in the 1950s and 1960s. This tradition had consistently focused attention on proactive ways people could become more positive and optimistic about life, master their moods, and fix their physical ills without taking medications. People could align their thoughts and constructively adjust their attitudes. Because mind and body were assumed to be closely interconnected—as physician and Declaration-of-Independence-signer Benjamin Rush had clearly indicated in 1811—it was taken for granted that harmonizing one's emotions in a positive way would, unquestionably, improve one's physical well-being.

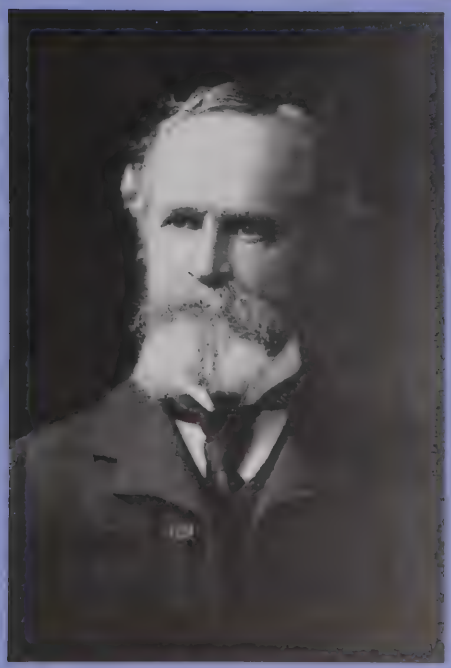


Benjamin Rush (1746–1813), **An Inquiry into the Effects of Ardent Spirits upon the Human Body and Mind, with an Account of the Means of Preventing and of the Remedies for Curing Them,** New York, 1811

In the United States, efforts to articulate the relationship between the care of the body and the state of the mind, morals and emotions date back almost 200 years.

Julia Anderson Root, **Healing Power of Mind: A Treatise on Mind-Cure, with Original Views on the Subject and Complete Instructions for Practice and Self-Treatment,** Peoria, Illinois, 1886

This American self-help tradition first developed in New England, where it was tied in with a variety of philosophical and religious currents.[27] It spread quickly to other parts of the country, as evidenced by Julia Anderson Root's *Healing Power of Mind* (first published in San Francisco in 1884) and Albert Vernon's *Correspondence Course of Instruction in the Science of Psychratism*. Medically-trained Harvard psychologist and philosopher William James took an active and supportive interest in what he called "The Religion of Healthy-Mindedness" which, he reported in 1902, "has recently poured over America and seems to be gathering force every day."[28] James claimed that "mind-cure gives to some of us serenity, moral poise, and happiness, and prevents certain forms of disease as well as science does, or even better in a certain class of persons."[29] Even physicians who worried about the excesses of the mind cure movement were forced to admit that cures of functional disorders often followed mind cure practice and that "physicians have failed for many years to pay sufficient attention to what may be aptly called psychical disorders of the body, or psychical conditions engendering functional derangements, or functional disturbances produced by psychical states."[30] A great concern of many turn-of-century medical practitioners, however, was that people with serious illnesses might never get to see a properly trained physician because they were so intent on curing themselves via mental self-adjustment.



William James

Notman (photographer)

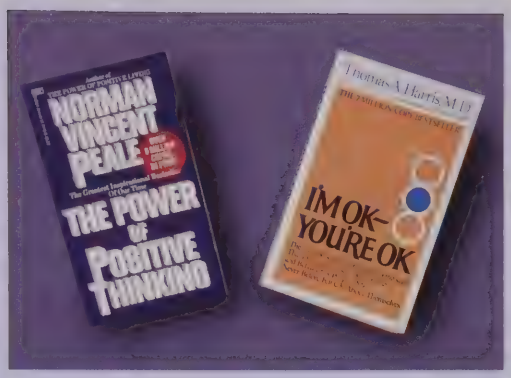
The blind have been made to see, the halt to walk; lifelong invalids have had their health restored. . . . One hears of the "Gospel of Relaxation," of the "Don't Worry Movement," of people who repeat to themselves, "Youth, health, vigor!". . .

William James
The Varieties of Religious Experience, 1902

Despite professional anxiety and disapproval, self-healing continued to spread in the twentieth century. John Kearsley Mitchell's *Self Help for Nervous Women* and Charles Fremont Winbigler's *How to Heal and Help One's Self* are just two examples of the literally hundreds of books, manuals, and magazines that were published in the early decades. Emile Coué's technique of "autosuggestion," according to which patients affirmed to their own image in a mirror that "Day by day, in every way, I am getting better and better," was just another, mildly hypnotic self-healing ritual which became a national fad in the early 1920s.[31] The creation of Alcoholics Anonymous in the thirties as a network of self-help groups drew from these same sources.[32] By the 1940s the self-help movement took on an increasingly secular, more psychological and less religious tone.[33] Dale Carnegie's *How to Stop Worrying and Start Living*, Norman Vincent Peale's *The Power of Positive Thinking*, and Thomas Harris's *I'm OK—You're OK* were later representatives of the genre, as was the "Laughter is the Best Medicine" feature in *Reader's Digest*. The emphasis on the positive role of upbeat emotions has been continued recently in Norman Cousins's many books and articles, even though Cousins rested his self-help advice more heavily on medical authority than did most of his predecessors.[34]

Focus on the salutary effect of optimism had another important consequence for medicine: it put long-standing popular enthusiasm for "cures," "remedies," devices, and so-called "patent medicines" in a new perspective. At the turn of this century, organized medicine fought a pitched battle with those purveyors of hope one historian has called the "Medical Messiahs"—and generally won, at least in the sense that in 1906 Congress endorsed the American Medical Association's campaign and passed the Pure Food and Drug Act, which banned false and fraudulent advertising and labelling practices.[35] The AMA was even more effective in curbing the commercial drug market by creating its own regulatory mechanisms for product testing and surveillance and by putting pressure on newspapers and magazines to refuse lucrative advertising revenues.[36] But astute physicians realized that well into the twentieth century, people continued to purchase extraordinary quantities of worthless nostrums—"Boyd's Batteries" and even "powdered unicorn's horn"—not merely because they were gullibly manipulated by quacks and cheats but because people believed that at least a few of these products, in some sense, really "worked." Patients often felt better after following a commercially purveyed regimen or swallowing a mass manufactured tonic. In certain cases they actually did get better. "Mental medicine" of some sort, the physicians assumed, was operating behind the scenes.

Many times before, physicians had confronted the phenomenon of misplaced public trust validated by apparently successful cures. One of the more notable episodes

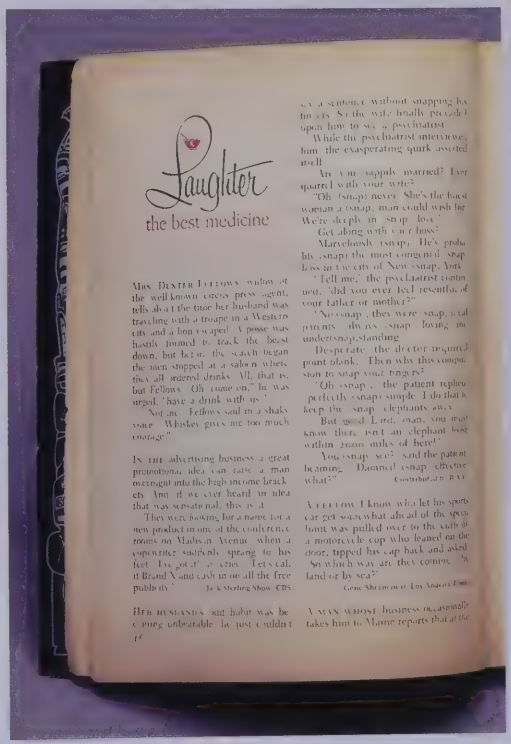


Norman Vincent Peale (1889–1994), **The Power of Positive Thinking,** New York, 1992, ©1952

Reproduced with permission of Random House

Thomas A. Harris (1913–), **I'm OK—You're OK,** New York, 1973, ©1967

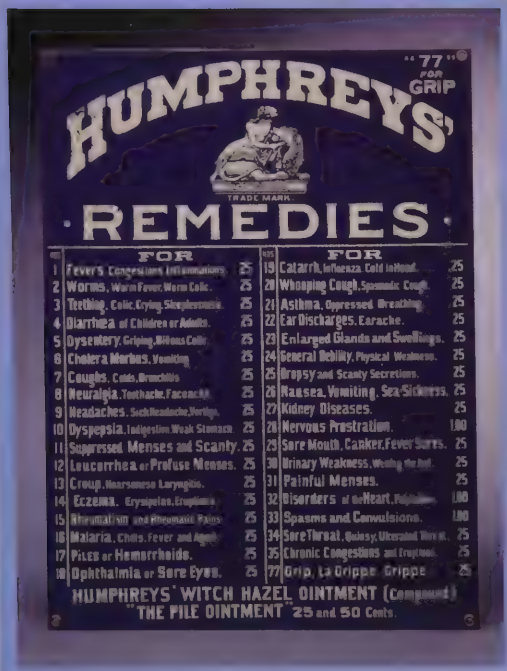
By permission of Avon Books


Laughter
the best medicine

"Laughter is the Best Medicine," **Reader's Digest,** April 1958

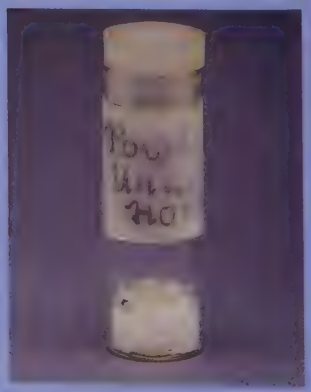
By the middle of the century, even such mainstream journals as **Reader's Digest** had absorbed the message that positive emotions were "good medicine."

Courtesy Ghilta Sternberg. Used with permission from Reader's Digest



Warner's Safe Cure Almanac and Book of Handy Information 1895, Buffalo, [illegible] from the National Library of Medicine, and a selection of "patent [illegible] from the collection of Elaine and Arthur Shapiro

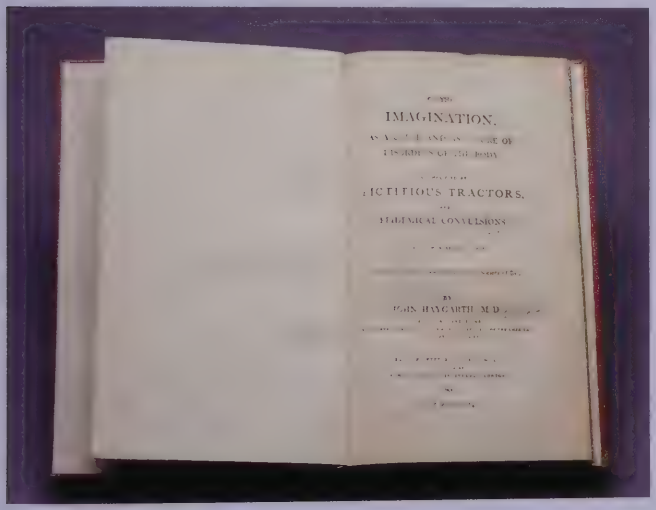
Unicorn's Horn
Courtesy Elaine and Arthur Shapiro



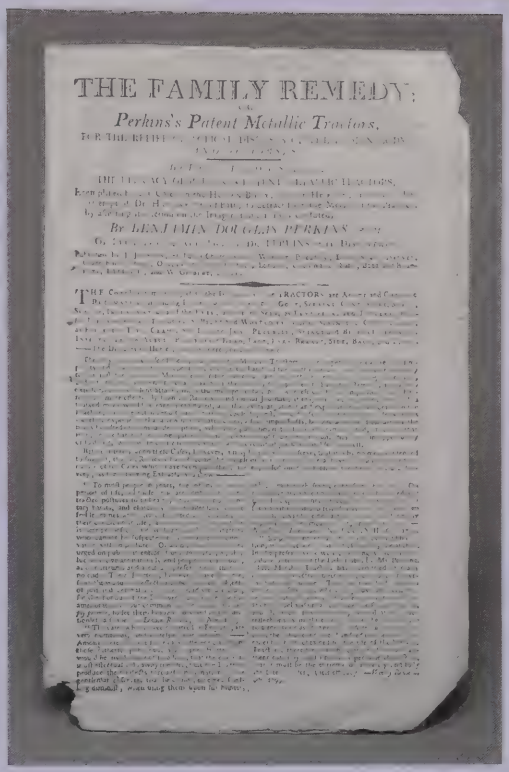
Powdered Unicorn's Horn
Courtesy Elaine and Arthur Shapiro

Perkins's Metallic Tractors

Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C.



John Haygarth, **Of the Imagination, as a Cause and as a Cure of Disorders of the Body; Exemplified by Fictitious Tractors, and Epidemical Convulsions,** Bath, 1800



Benjamin Douglas Perkins (1774–1810), **The Family Remedy; or, Perkins's Patent Metallic Tractors, For the Relief of Topical Diseases of the Human Body; and of Horses,** London, 1800

Four Batteries

Perkins's Metallic Tractors may have been exposed as fraudulent, but the public has repeatedly resisted the cautions of the medical establishment and continued over the years to "discover" the therapeutic power of similar kinds of objects. In this century, "Boyd's Batteries" and similar objects were worn around the neck to improve flagging energy and soothe various aches and pains.

Courtesy Elaine and Arthur Shapiro

involved a patented device called "Perkins's Metallic Tractors." These little pins were advertised as curative for "topical diseases" from gout to rheumatism. Many discerning people, including George Washington, testified that the tractors worked. Dr. John Haygarth attempted to expose the fraud (he found that wooden pins worked as well as the allegedly metallic ones that were supposed to channel the body's "galvanic" electricity) in a tract entitled *Of the Imagination, as a Cause and as a Cure of Disorders of the Body; Exemplified by Fictitious Tractors, and Epidemical Convulsions.* Haygarth's attempt to discredit a popular fad by highlighting the therapeutic role of aroused imagination was repeated by other medical authors, perhaps most impressively in the widely read *Illustrations of the Influence of the Mind Upon the Body In Health and Disease, Designed to Elucidate the Action of the Imagination*, written by the respected British psychiatrist Daniel Hack Tuke. Tuke exhaustively documented the Perkins episode but concluded with a critique of the medical profession. Those physicians like Haygarth who debunked Perkins by pointing triumphantly to the role of the "imagination" and then dropping the issue without seeming to care whether or not patients actually improved, displayed a behavior that struck Tuke "as astonishing as that the public should believe in, and allow themselves to be cured by, the metallic tractors."[37] By 1900 a sizeable group of American physicians regularly invoked Tuke as a weighty authority as they battled against both public credulity and seeming professional indifference to "mental medicine."

The issue was quite complicated and compromised for physicians. Many of them were aware that they too prescribed medications whose principal basis of action was the

Sir William Osler (1849-1919)

In the fight which we have to wage incessantly against ignorance and quackery among the masses and follies of all sorts among the classes, diagnosis, not drugging, is our chief weapon of offence.

William Osler
Aequanimitas, "Chauvinism in Medicine," 1904

patient's credulous belief. The term "placebo" was long used in medicine for a prescribed substance thought to be medically inert but helpful for cajoling or controlling "neurotic" patients by giving them something in which to believe and by which they might be "cured."[38] The most experienced and sophisticated physicians knew that many medicines thought to be effective were really not, at least not on the basis of pharmacological principles. The regular profession was itself often guilty of "over-drugging." Thus William Osler, the beloved and influential turn-of-century professor of medicine at Johns Hopkins University, could slap down quacks and jab at his colleagues at the same time by saying, "In the fight which we have to wage incessantly against ignorance and quackery . . . *diagnosis*, not *drugging*, is our chief weapon of offense." Some went even further. Lewellys F. Barker, Osler's successor as professor of medicine at Hopkins, suggested that whatever success modern physicians had with their prescribed medications depended largely on their ability to "awaken confidence and inspire the idea of authority by their scientific training and by their mode of inquiry and of examining the patient."[39] Even more provocatively, Harvard professor of psychiatry C. Macfie Campbell declared in a much noted 1924 lecture that physicians sometimes brought about the improvement of their patient "unwittingly, when the patient is already prepared for the display of power." "It is well to realize," he cautioned, that the patient "who comes from afar to a great medicine-man with these wonderful machines, which extract wisdom from the air, is already halfway on the road to recovery."[40]

Thus the groundwork was laid for the serious investigation of the role of hope, imagination and expectation in the operation of medications and procedures in scientific medicine. W.R. Houston defined the issue clearly in a 1937 address to the American College of Physicians when he said, "The great lesson . . . of medical history is that the placebo has always been the norm of medical practice."[41] Eugene F. DuBois, professor of medicine at Cornell University,

You cannot write a prescription without the element of the placebo. A prayer to Jupiter starts the prescription. It carries weight, the weight of two or three thousand years of medicine.

Eugene F. DuBois
"The Use of Placebos in Therapy," Cornell Conferences on Therapy, 1946

expressed similar sentiments in 1946. By this time drug companies were marketing code-named placebos for use in clinical practice. Soon afterwards, scientists conducted experiments on placebo effects. This coincided, not accidentally, with the period when the pharmaceutical industry was producing penicillin and other "wonder" drugs whose full power and range of action had not yet been tested and when psychosomatics had become a central concern of mainstream medicine.[42] Rigorous studies, often measuring placebo effects in experimental drug trials, multiplied rapidly, more being published in the four years from 1954 to 1957 than in all prior

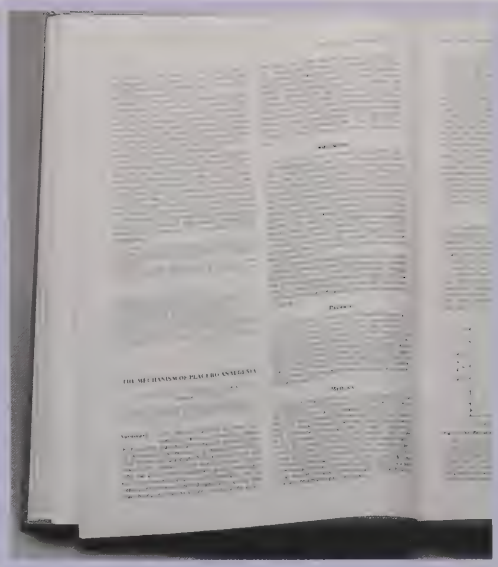
Placebos were produced for clinical use in a range of different shapes and colors, and physicians even discussed which colors and shapes worked best. Bottles were labeled with simple code names (Cebocap, Obecalp) so patients would not catch on to the fact that they were being given a placebo rather than a real drug.

Milk sugar (or lactose) was the classic placebo that physicians sometimes used in their clinical practice. This bottle of milk sugar placebos was produced for clinicians by Merck Pharmaceuticals

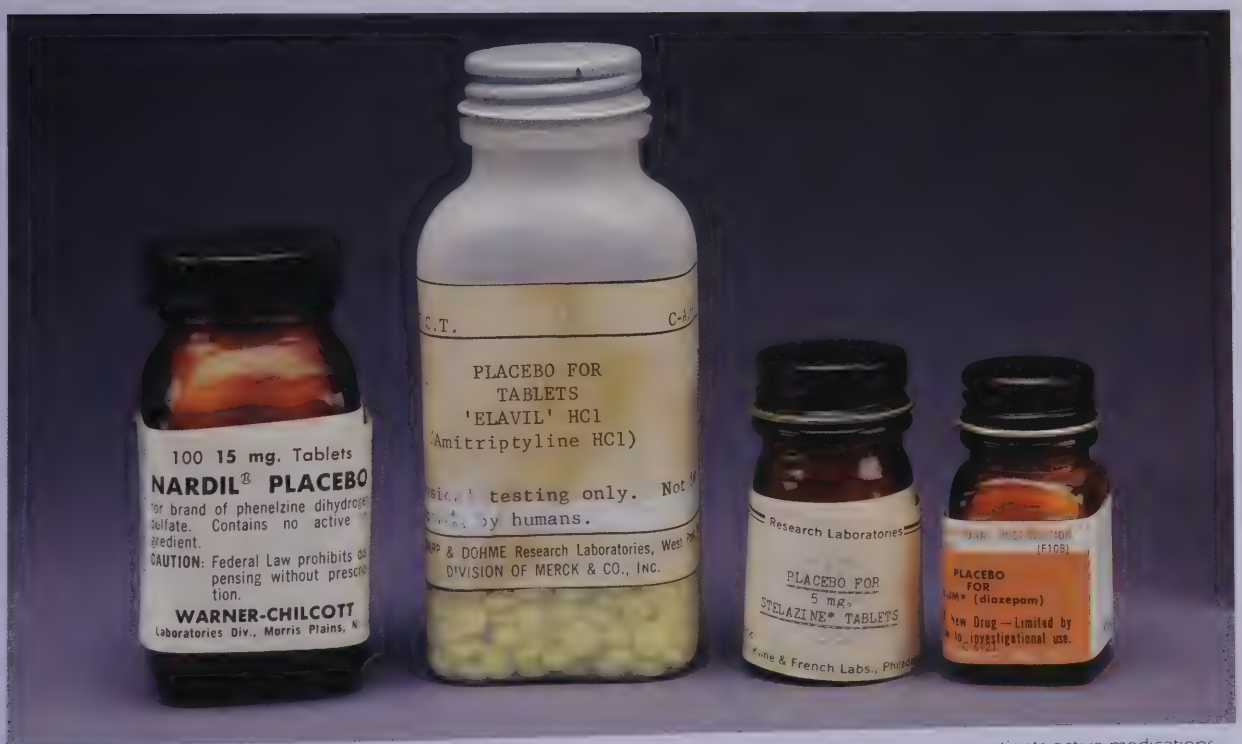
Courtesy Elaine and Arthur Shapiro

years combined. In 1955 one of the leading young investigators, Louis Lasagna, was invited to write about placebos in *Scientific American*, a clear sign that the field had "arrived."[43]

Serious work on placebos continued over the next two decades. Investigators pursued many fruitful lines of research, but two of the most productive turned out to be the exploration of psychological mechanisms in experimental subjects identified as "placebo reactors"[44] and the specification of the brain biochemistry which underlay placebo effects.[45] In one of the most suggestive studies in this second line of research, published in *The Lancet*, Levine, Gordon, and Fields concluded that the activity of "endogenous opioids"(the body's own opium-like substances) accounts for "placebo analgesia." Although there are many unanswered questions, by the late 1970s it appeared as if both clinicians and basic scientists had accepted the placebo effect as a central phenomenon in medicine—indeed, as one of the body's arsenal of self-protective weapons—and thought it ultimately explicable in the most modern biochemical terms.



Jon D. Levine, Newton C. Gordon and Howard L. Fields, "The Mechanism of Placebo Analgesia," **The Lancet**, September 23, 1978



By the 1950s, medical researchers began to use placebos in a different way. In drug trials, they gave some patients active medications and others dummy drugs that looked identical—and then compared the therapeutic results. The idea was not to learn about the placebo effect in its own right, but to sort out the "real" effect of an active drug from the "merely psychological" effect of its placebo. Pharmaceutical companies produced these placebos in the 1960s for use in testing a range of antidepressant medications.

Courtesy Elaine and Arthur Shapiro

Long Island Expressway

The stress of everyday life often begins with the drive to work.

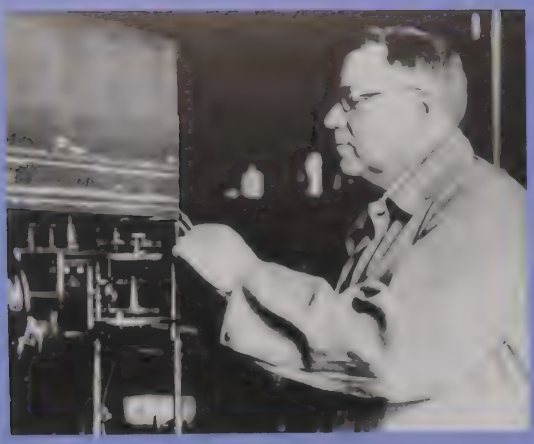
Courtesy, Peter Gridley/FPG

Stress and Deprivation

During the same few decades which saw great advances in the understanding of placebos, psychosomatic medicine also underwent significant changes, both in the research and clinical field and in the wider area of popular interest. The most important changes centered on the virtual abandonment of ideas about the role of unconscious emotions, early childhood experiences, and personality peculiarities—all derived from psychoanalysis. These ideas were replaced by a focus on manifest emotions, current life situations, and the socio-environmental circumstances in which disease occurred.[46] Scientists often stated the newer formulations in terms of maladaptation and loss or, more commonly, "stress" and "deprivation." Researchers drew from physiological theory and experiment and extended their concepts to all diseases, not just the classic "psychosomatic seven" (which included peptic ulcer, asthma, hypertension and, depending on the psychosomatic texts, colitis, cardiac arrhythmia, neurodermatitis, and hyperthyroidism). Yet at the same time that scientists broadened the range of emotion-disease connections, the once almost unquestioned presumption of psychogenic etiology for the "psychosomatic" diseases gave way to an increasingly somatic orientation. In the realm of therapy and disease management, individual psychotherapy was replaced by stress reduction, structured mobilization against feelings of loss and loneliness, and increased reliance on the therapeutic options of biomedicine.

The decline in the medical popularity of psychoanalysis, evident in the late 1950s and continuing in the 1960s and 1970s, set many of these changes in motion.[47] Leading researchers submitted analytically-based theories of peptic ulcer, asthma and ulcerative colitis to searching criticism and substantial revision. Therapeutic approaches relied more and more on new drugs and medical interventions and less and less on psychodynamic psychotherapy.[48] In the most dramatic case, scientists have recently attributed the cause of peptic ulcer to a spiral bacterium, best managed clinically with antibiotics. This new movement even attacked conversion hysteria—one of the major contributions of Freud and a mainstay of psychosomatic theory. Several important critics started picking at the loose and unreflective consensus that had come to surround symbolically interpreted hysteria. One of the most influential critics, the respected neurologist Eliot Slater, in a widely noted paper published in 1965, called the diagnosis of conversion hysteria "a disguise for ignorance and a fertile source of clinical error."[49]

This discrediting of psychoanalysis created a widening gap in psychosomatic thought that was steadily filled by a variety of theoretical alternatives. These concepts rested on more directly observable and less arcane linkages between



Walter Bradford Cannon

Walter Bradford Cannon (1871–1945), **Bodily Changes in Pain, Hunger, Fear and Rage: An Account of Recent Researches into the Functions of Emotional Excitement**, New York, 1915

Reproduced with permission from Appleton and Lange

Taught to deal with concrete and demonstrable bodily changes, we are likely to minimize or neglect the influence of an emotional upset, or to call the patient who complains of it "neurotic," perhaps tell him to "go home and forget it," and then be indifferent to the consequences. But emotional upsets have concrete and demonstrable effects in the organism.

Walter B. Cannon
The Role of Emotion in Disease, 1936

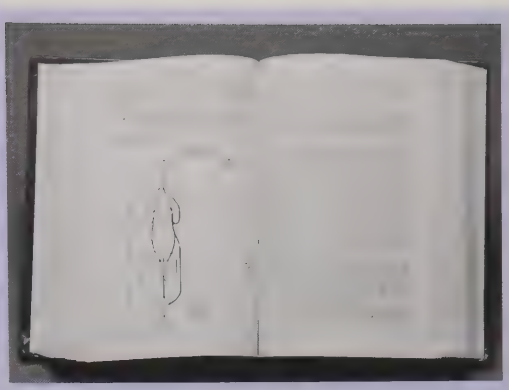
emotions and the onset of disease. However much these theoretical alternatives differed, they had in common a psychobiological orientation, in the sense that they were clearly based on notions of holistic body and mind response of the total human organism to various stimuli, threats and assaults from its environment. A common origin explained the similar orientation of these new theoretical approaches, for they all derived in some sense from the fundamental work of early twentieth-century Harvard physiologist Walter B. Cannon. Cannon's general program was to show how the biological organism automatically mobilized its physiological and biochemical resources by a built-in "wisdom of the body," to defend itself against real or threatened assault. As an example of defensive mobilization, he explained in *Bodily Changes in Pain, Hunger, Fear and Rage*, the organism responds to fear and rage as though preparing for fight or flight, by shutting down energy-storing functions and activating energy-releasing ones. In the 1940s, psychosomatic investigator Harold G.

Wolff and his associates at Cornell Medical School incorporated many of Cannon's ideas.[50] Wolff then moved from a model of organismic self-defense directly borrowed from Cannon to a generalized notion of "stress and disease," according to which disease was the "inept" version of a normally "apt protective reaction pattern" that allowed the human organism to mobilize against stressful situations or events.[51]

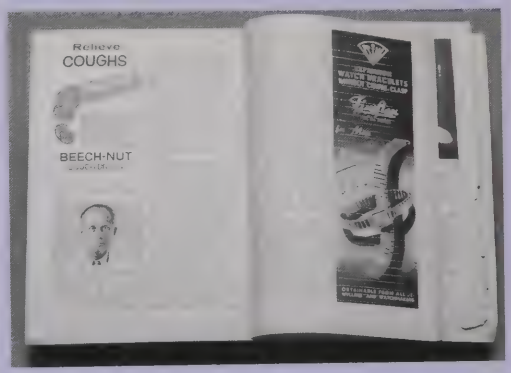
Stress became a leading new idea in psychosomatic theory in the 1950s and Hans Selye emerged as its best known and most effective proponent. Selye was a Vienna-born, Prague-trained physician and biochemist who settled in Montreal in the 1930s and wrote the leading endocrinology textbook in 1947. In 1950 he published a 1,025-page monograph entitled *The Physiology and Pathology of Exposure to Stress*, in which he elaborated ideas he had been developing since 1936 on what he called the "General Adaptation Syndrome."[52] Selye's theory was that various "stressors" (cold, heat, solar radiation, burns, "nervous stimuli") produce a generalized, stereotyped response in the biological organism as it works to "perform certain adaptive functions and then to reestablish normalcy." As the organism automatically mobilizes its defense mechanisms, the hypothalamus (a nerve center at the base of the brain) is excited first. Later, after a chain of effects, the adrenal glands produce "corticoid" hormones. Corticoid hormones cause a characteristic set of somatic reactions including the development of gastrointestinal ulcers.

Due largely to their synthetic scope, Selye's ideas swept the field and exerted an enormous influence. As F.L. Engel noted in 1956, "[Selye's theory of stress and the diseases of adaptation] has permeated medical thinking and influenced medical research in every land, probably more rapidly and more intensely than any other theory of disease ever proposed."[53] The "stress syndrome" became even more popular and widely known in the sixties, partly because of its appeal as a replacement for older, increasingly discredited psychoanalytically-based psychosomatic theories and partly due to Selye's charisma and prodigious output. He published forty books and over 1,700 scientific papers in the course of his career.[54] Selye was frequently quoted throughout medicine, nursing, and other health fields, and his fame spread to the wider culture, a reputation he deliberately cultivated by publishing such books for the general reader as *The Story of the Adaptive Syndrome* (1952), *The Stress of Life* (1956 and 1976), and *Stress Without Distress* (1974). Yet by the 1970s there was discord in the field of stress research as Selye conceived it. Growing confusion and controversy riddled theory and experiment. Some critics blamed Selye for having caused a great deal of it with his conceptual inconsistencies and his shifting and sometimes contradictory formulations.[55]

One major alternative challenged the stress model during the height of its initial popularity. George Engel and his colleagues at the University of Rochester Medical Center

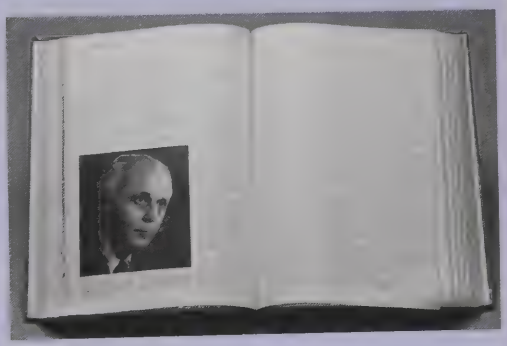


Hans Selye, **The Physiology and Pathology of Exposure to Stress,** Montreal, 1950



Reader's Digest, February 1957

Courtesy Ghilta Sternberg. Reproduced with permission from Reader's Digest



American Journal of Nursing, March 1965

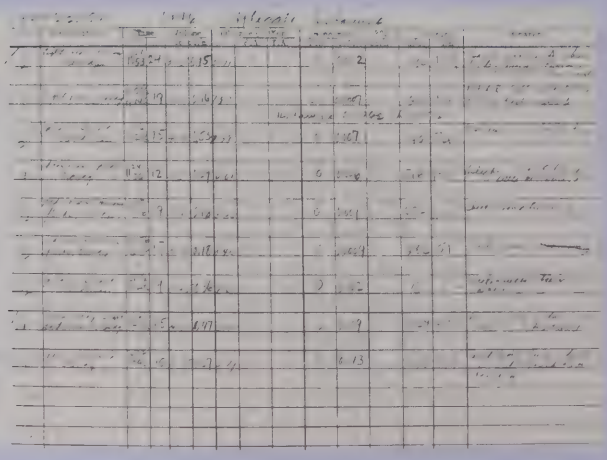
Used with permission of Lippincott-Raven Publishers

developed a theory they ultimately called "conservation-withdrawal." Like Selye, Engel and his associates focused on psychobiological threats to an individual's well-being. But instead of considering threats as "stressors" that elicited defensive and protective behaviors from the hyperaroused organism, the Rochester group conceptualized the most important of these behaviors in terms of "losses" and "deprivations" that caused the organism to become withdrawn, depressed and shutdown.[56] The Rochester group was generally attuned to psychoanalytic theory and remained committed to preserving a place for it even in post-Alexandrian psychosomatic medicine. They thus developed a complex scheme framed in terms of disrupted relationships between individuals, affects of "helplessness" and "hopelessness," and a state of "conservation-withdrawal" in which physiological function was depressed to the point of creating a "final common pathway" to illness and death.

The Rochester group's work grew at the juncture between clinical studies on such diseases as leukemia and ulcerative colitis[57] and a naturalistic experiment on an infant, "Monica," who was fortuitously admitted to Rochester's Strong Memorial Hospital during the course of their work.[58] Monica had been born with a blockage in her esophagus, which required that two surgical openings be made, one in her neck to drain anything she took by mouth and one in her

Monitoring Monica's gastric (stomach) secretions, Engel and his associates found that physiological activity increased sharply, not only in the presence of food, but in the course of Monica's interactions with other, trusted human beings. Joyful reunions following separation were associated with especially copious secretions. At the same time, when Monica emotionally disengaged and withdrew—for example, in the presence of a stranger—there was a pronounced shutdown of physiological activity. In a sense, the body "withdrew" also, as if trying to conserve resources.

Courtesy Dr. George Engel



stomach through which she could be fed. Monica did not do well and was admitted to the hospital at fifteen months in a dangerous condition. While she was being nursed back to health, Engel and his associates designed a study in which they measured her gastric secretion continuously and correlated their observations with Monica's moods. They found that Monica's physiological activity increased when she was engaged with the members of the group, whether joyfully or angrily, and especially on reunion after separation. By contrast, her gastric secretion ceased entirely, and even became unresponsive to histamine (which normally stimulates gastric secretion), when she withdrew physically and emotionally from a stranger who replaced the familiar members of the group. Monica's behavior made sense as a psychological and physiological shutdown that served to conserve her organismic resources. It also helped put into perspective the separately collected clinical data on patients who articulated feelings of "giving up" or being "given up" shortly before the onset or exacerbation of a variety of somatic diseases.[59]

By the 1970s the psychosomatic field thus had a pair of new concepts, one emphasizing stress-induced hyperarousal and the other deprivation-caused hypoarousal. A major achievement of the next decade was the merger of this pair of ideas into one model of socio-environmental challenge and response and the connection of that model with other streams of work focused on "life change events" (divorce, bereavement, and job loss) and "social stressors" (high intensity living and work situations and major social dislocations from normal support networks).[60] The seventies were also notable for the application of progressively more sophisticated biostatistical techniques and more rigorous epidemiological study designs.[61] Striking landmarks were Sidney Cobb and Robert M. Rose's study of "Hypertension, Peptic Ulcer, and Diabetes in Air Traffic Controllers," the 1973 conference in New York City on "Stressful Life Events," John Cassel's Wade Hampton Frost Lecture of 1976 at the American Public Health Association on "The Contribution of the Social Environment to Host Resistance," and David Jenkins's report in the *New England Journal of Medicine* the same year of substantial evidence confirming the significance of the "Type A" behavior pattern as a risk factor for coronary artery disease.[62] Although there were critics of some of this new work in psychosomatic medicine, the strong consensus in the 1970s—both within the psychosomatic field and more broadly in science and medicine—was that studies on the relationship between social support, life stress, and disease onset were significant and very promising for the future.[63] It was well established in the popular imagination that the stress of modern life, work-related tension and anxiety, and devastating tragedy accompanied by the loss of community could lead to very severe health consequences.

Also notable in the seventies was the translation of

Dismissal (or) Pink Slip
Howard Taft Lorenz

The shock to the system caused by loss and broken trust is starkly captured in this WPA painting by Lorenz.

Courtesy National Museum of American Art, Smithsonian Institution, transfer from Museum of Modern Art

B. Kent Houston and C.R. Snyder, editors, **Type A Behavior Pattern: Research, Theory, and Intervention,** New York, 1988

Reproduced with permission from John Wiley and Sons, Inc.

The chief and primary cause of . . . [the] very rapid increase of nervousness is modern civilization, which is distinguished from the ancient by these five characteristics: steampower; the periodical press, the telegraph, the sciences, and the mental activity of women.

George M. Beard
American Nervousness, Its Causes and Consequences, 1881

Saratoga Spa, N.Y., *ca. 1950s*

A vacation "in the country," away from the routines of life, remains a tried-and-true remedy for "stress."

Courtesy Ghilta Sternberg

new theoretical insights into practical intervention strategies, sometimes actively promoted by the researchers themselves. Thus, Meyer Friedman and Ray Rosenman, the physicians who initially defined the Type A concept, published a popular book which included practical chapters on how to "re-engineer" one's daily life and develop "drills" to replace old and harmful habits.[64] Similarly, Harvard's Herbert Benson promoted a simple, "noncultic" technique to elicit the "relaxation response" as a counter to the stress-induced "emergency response." He showed that physicians could teach the relaxation response to patients as either a preventive or therapeutic strategy.[65] Several other investigators introduced "biofeedback" techniques (in which various physiological variables such as heart rate and muscle tension were displayed to the patient) as practical clinical methods for managing hypertension and a variety of other conditions.[66] In work settings, employers introduced timeouts for stress-reducing exercise sessions and even redesigned the production process itself. Of course, the time-honored "vacation in the country" or "stay at the spa" remained popular outlets for people's accumulated tension. But in a period sensitive to the importance of loss as well as overload, health practitioners introduced newer interventions to affiliate isolated and vulnerable people with one another through support groups, to provide them with beloved objects of affection, and to encourage shared group solidarity of great symbolic and emotional significance. If stress and deprivation could cause disease, relaxation and reconnection may be able to cure it or, at least, mitigate its effects.

Dilbert, Scott Adams, September 15, 1996

Scott Adams, creator of the popular comic strip **Dilbert,** has updated the idea of "office stress" for the economically insecure 1990s.

Volvo Assembly Line, Sweden

In 1987 the Volvo Truck Corporation initiated a significant effort to improve the environment of its factories and alter the assembly process. Scientists documented blood pressure, stress hormones and attitudes of workers before and after restructuring the way car and truck engines were put together and found that after the changes, perceived stress, blood pressure and epinephrine levels of the employees decreased and morale increased.

Courtesy Volvo Truck Corporation, Powertrain Division, Skövde, Sweden

Positron emission tomography or PET scanning—one of several new imaging techniques—tracks the course of high energy, very short-lived radioactive compounds through the brain. In this way, a "map" is created of the brain's changing blood flow and chemistry as a person thinks and feels.

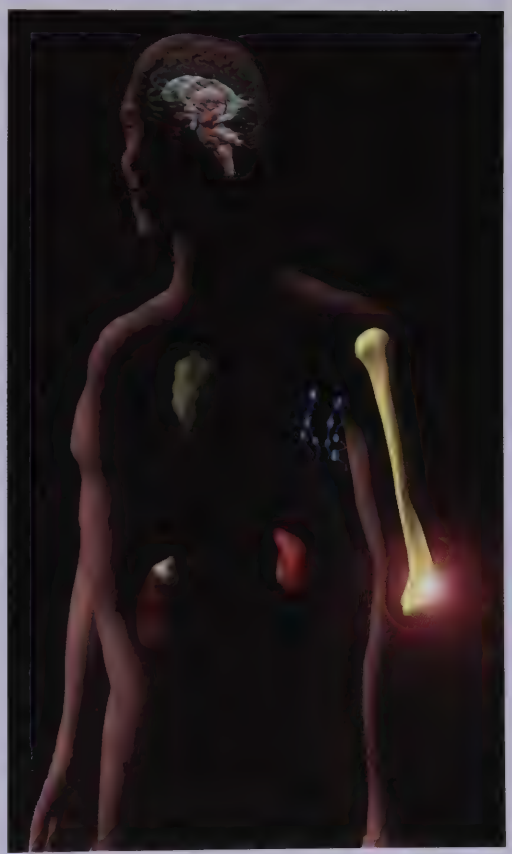
Courtesy GE Medical Systems

Frontiers of the Mind

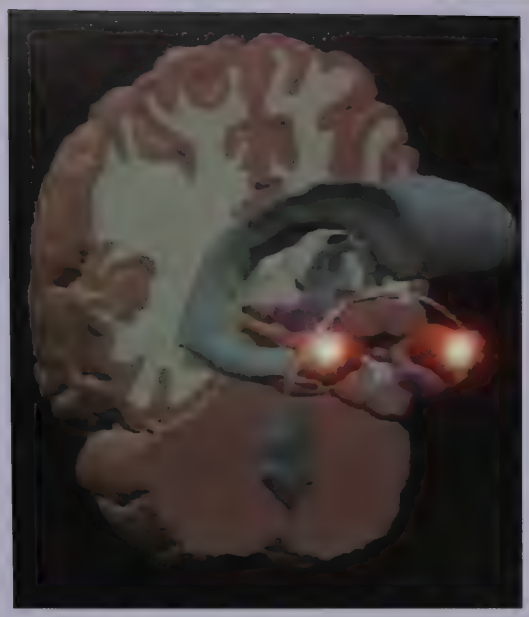
Two of the most compelling features of the last twenty years have been dramatic achievements in the laboratory and striking advances in biomedical technology. Together, they have literally extended the frontiers of the mind by embodying emotions in the biology of the brain more successfully than ever before and by creating the possibility of identifying the intricate interconnections between brain-based emotions and the functioning of the neuroendocrine and immune systems. Spectacular developments in laboratory science and visualization technology have been essential components of the explosive development of neuroscience, a field which has quickly become one of the most respected, exciting and actively pursued in medicine.[67] Within the neurosciences an area variously called "psychoneuroimmunology" and "neuroimmunomodulation"[68] has recently emerged which seems on the verge of tracing the pathways between emotions and disease whose connections had long been glimpsed in clinical contexts by physicians ranging from Galen to Freud and from Maimonides to Alexander.

The modern grounding of emotional expression in the biology of the brain began with the work of the American neuroanatomist James Papez. In 1937, Papez argued from anatomical and clinical evidence that an "ensemble of structures" in the lower, subcortical areas of the brain constituted the "anatomic basis" and "harmonious mechanism" for the elaboration and expression of emotions. Rejecting the possibility that emotion is "a magic product," Papez insisted that it is "a physiologic process which depends on an anatomic mechanism."[69] Papez's ideas were effectively promoted by Paul MacLean, a physician and neurophysiologist. In 1949, MacLean proposed a hypothesized "visceral brain" as an anatomical and functional system intermediate between the "intellectual" cortex and the "discharging" hypothalamus. This system was "largely concerned with visceral and emotional functions."[70] In the 1950s, MacLean generalized his ideas into a theory of the "limbic system," an integrated set of subcortical structures in the brain including the hippocampus and amygdala whose precise role in emotional expression and modulation he explored through the electrical and chemical stimulation of specific anatomical regions and structures.[71] Other investigators added human clinical evidence and the results of surgery on the brains of laboratory animals, which also pointed to the role of the limbic system in the expression of emotions.

Interest in the limbic system remained strong through recent times, although in the last several years neuroscientists have raised questions about the looseness of some of the earlier theoretical assumptions and anatomical constructs. They are still interested in the neural substrates of



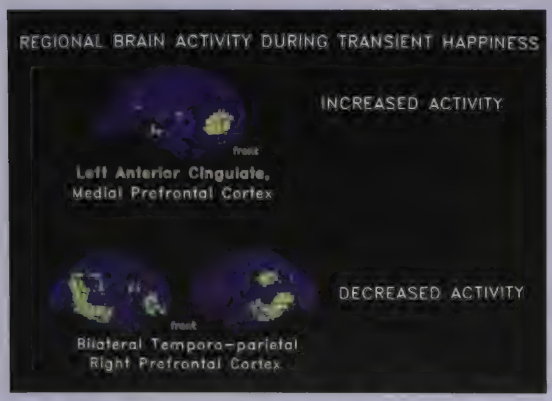
The organs of the immune system (thymus, spleen, and lymph nodes) and the organs of the neuroimmune system (adrenal gland, hypothalamus, and the cortical and subcortical brain).

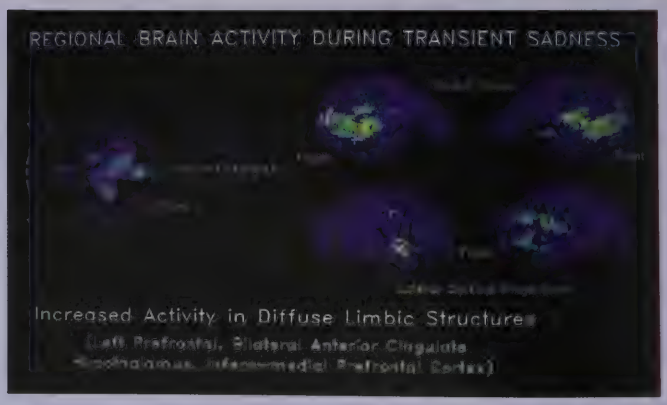


An overactive amygdala

emotion within the brain but have shifted their attention to the hemispheres of the cerebral cortex and to the interactions between cortical and subcortical regions. In the 1970s, neuroscientists began to concentrate on the right cortical hemisphere as the most interesting locus of emotional control.[73] Roger Sperry's award of the Nobel Prize in 1981 for his work on "cerebral laterality" (the differences between the "left" and the "right" brain and their behavioral significance) reinforced this trend, but respected neuroscientist R.W. Doty indicated in a 1989 review article that "any idea of emotion in an intact mammal being played out purely via subcortical circuitry is an unsustainable abstraction. On the other hand, the evidence is unequivocal that subcortical structures are essential for the expression of the more 'primitive' emotions, and can support such expression in the absence of the neocortex."[74] Current work is verifying the integrative functioning of cortical and subcortical areas (especially the amygdala) in the organism's response to primitive emotional experiences such as fear.[75]

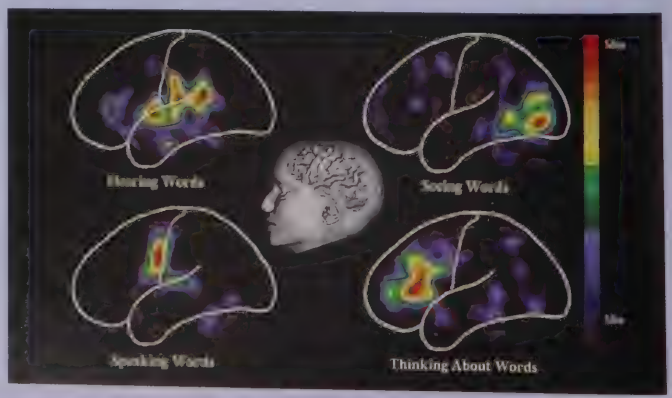
Powerful new imaging techniques have supported and made possible the recent emphasis on the anatomical substrates of emotion.[76] The most impressive techniques are computer assisted tomography (CAT scans), magnetic resonance imaging (MRI), positron emission tomography (PET





Using PET scans, scientists are in the first stages of relating different emotional states—pleasure, sorrow—to different patterns of brain activity.

Courtesy Mark S. George, Medical University of South Carolina, Charleston



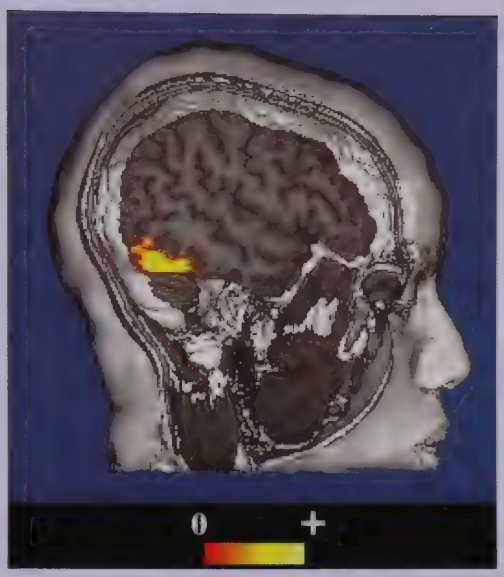
PET scans of people who have been asked to look at, listen to, speak or think about a word. Different parts of the brain become active, depending on how the word signal is received

Courtesy Marcus E. Raichle, Washington University, St. Louis, Missouri

scans), single-photon emission computed tomography (SPECT), and functional magnetic resonance imaging (fMRI). The breakthrough technology was computer assisted tomography, developed in the 1960s and 1970s, for which Allan Cormack and Godfrey Hounsfield received the Nobel Prize in 1979. The basic principle was the computer synthesis of a three-dimensional image from a series of two-dimensional "slices" taken at multiple angles (tomography) of some signal aimed at or emanating from the patient and detected outside his or her body. This principle was applied first to CAT scans where the measured property was an x-ray attenuation coefficient. The same principle was then applied to MRI imaging and PET scans, where the measured property was natural magnetization density in the first case and the concentration of an intravenously injected radioisotope in the second.[77] The newer fMRI is based on the tomographic construction of images formed by the signal differences between MRIs taken of the brain in functionally activated and non-activated states.[78] CAT scans and MRI images are now widely used in clinical settings to determine anomalies in cerebral anatomy. SPECT, PET and fMRI are valuable tools, at this point employed primarily in research settings to determine physiological and biochemical variations in brain activity, including anatomically-localized alterations in metabolism and neurochemical functioning which are visualized as they occur.[79]

Many of the achievements in the neurosciences have come at the intersection of this new imaging technology with recent breakthroughs in neurochemistry.[80] As one of neurochemistry's leaders, Solomon Snyder, has said, "The glue that has brought together findings from so many different disciplines into a coherent concept of brain function is chemistry. Indeed the revolution is more precisely characterized as a revolution in 'molecular neuroscience.'"[81]

Twenty years ago, Snyder was among those neurochemists who succeeded in identifying opium-like molecules in the brain (variously called "enkephalins," "endorphins," or sometimes just "endogenous opioids") that helped regulate the sensation of pain. Endogenous opioids are a type of "neurotransmitter," a long-studied class of biochemical substances that convey messages from nerve fiber endings to other biological receptors, whether nerve, muscle or gland. Neurochemists were able to identify specific opiate "receptor sites" where the endogenous opioids normally attach but at which they are sometimes displaced by exogenous competitors such as morphine. Using photographic techniques that take pictures of samples incorporating radioactive materials and high power microscopy, scientists found large concentrations of these receptor sites in areas of the brain (in the limbic system) specifically associated with pain perception and other forms of emotional regulation.[82] More recently and with the help of PET scan and fMRI technology, neuroscientists have

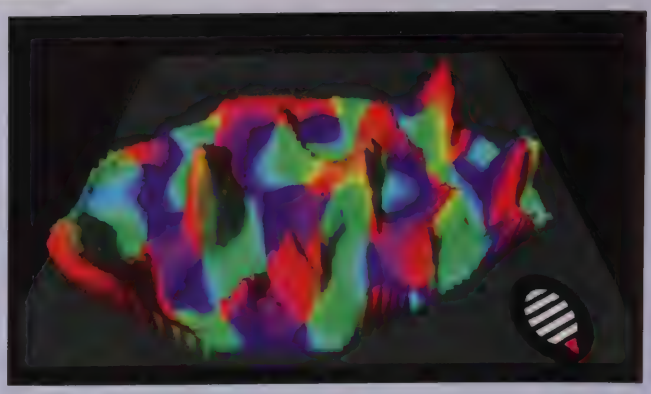


Functional magnetic resonance imaging, or fMRI, is another new technology that can detect the living brain at work. This is a computer-enhanced fMRI scan of a person who has been asked to look at faces. The image shows increased blood flow in the part of the visual cortex that recognizes faces.

Courtesy V.P. Clark, K. Keil, J. Ma. Maisog, S. Courtney, L.G. Ungerleider, and J.V. Haxby, National Institute of Mental Health

Optical imaging camera.

Courtesy Photometrics



The optical imaging camera allows scientists to peer even more deeply into the brain, making pictures of nerve cells working together in ensembles. A bright light shone onto the brain reflects back changes in nerve cell activity (measured through changing colors related to water content, cell size, and amount of oxygen in the blood). These are then turned into colorful images.

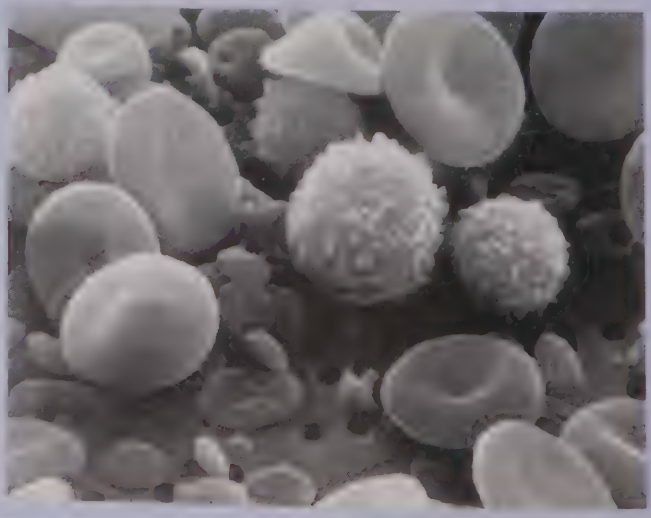
Courtesy Ehud Kaplan and Richard Everson, Mount Sinai School of Medicine, New York

New technologies, like computerized photomicrographic imaging, are bringing even the microscopic world of cells and genes more fully into the light of day.

Courtesy Leica Inc., Deerfield, Illinois

Computerized imaging microscopes combined with molecular biology techniques for staining tissue show activated genes in the hypothalamus at the site they are expressed (in situ hybridization).

Courtesy Miles A. Herkenham, National Institute of Mental Health



The scanning electron microscope allows scientists to see lymphocytes, red blood cells, macrophages and monocytes.

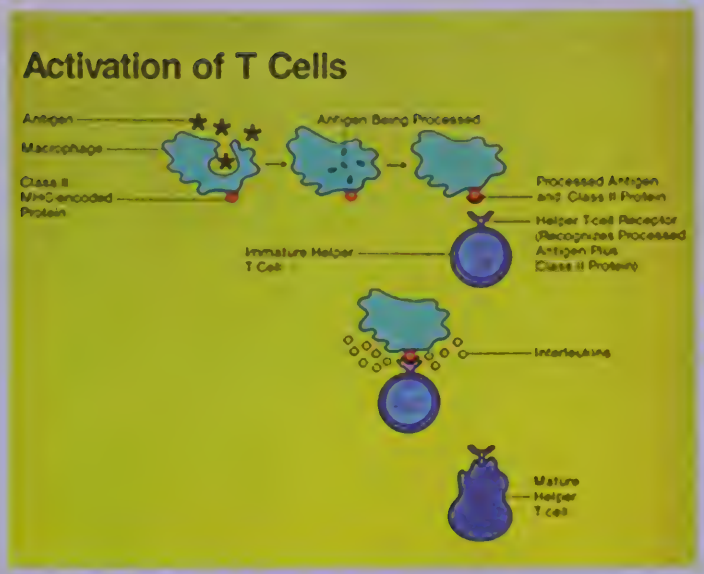
Courtesy Bruce Alberts and Harry Schaefer, National Cancer Institute

been able to confirm the dense distribution of opiate receptors in the structures of the limbic system and especially in the amygdala. Neuroscientists thus seem to be closing in on both the biochemical mechanisms and the anatomical architecture of emotional expression in specific structures of the brain.

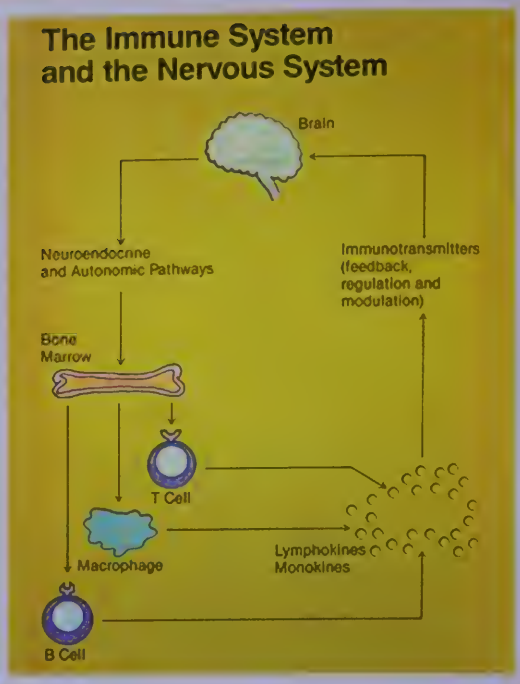
In perhaps the most exciting development of all, a new field has emerged which is starting to combine the latest in the neurosciences with the latest in immunology to provide the scientific basis for understanding relationships between emotions and disease once explored only in clinical settings. Not yet possessing a generally agreed upon name, this new field has been able to demonstrate previously unsuspected but now verifiably direct connections between the immune system and the neuroendocrine system. The field developed in two waves. The first wave, rising in the late seventies and early eighties, was generally called "psychoneuroimmunology" (PNI). Its roots could in some sense be traced back to the pioneering studies of the Russian immunologist S. Metal'nikov at the Pasteur Institute in Paris in the 1920s and 1930s and to the considerable work in the Soviet Union from the 1920s through the 1950s on psychologically conditioned immunobiological effects. The field really began to take shape around 1980 under the combined leadership of the Americans George Solomon, Novera Herbert Spector and Robert Ader, the Swiss Hugo Besedovsky, and the Russian Elena A. Korneva.[83] Although each of these leaders came from a different discipline and contributed different specific expertise (Ader, for example, was an experimental psychologist, Solomon was a psychiatrist and Besedovsky was an endocrinologist), they all agreed on the need to break down the barriers that until then had artificially separated immunology as a field from endocrinology and the neurosciences. As Ader and his colleagues put the point in 1987, "In our view, the attempt to understand immunity as an adaptive process that is independent of and can be studied in isolation from other integrated adaptive processes is, in its extreme form, a restrictive and restricting paradigm."[84]

Beginning in the late 1980s, the second wave was marked by the recruitment of molecular neuroscientists. This phase does not yet have a fixed name, although "neuroimmunomodulation" (NIM) is widely accepted, while some leaders prefer simply "neuro-immune interactions." Some of the scientists recruited to the field during this phase were wary of PNI and remained skeptical until they were persuaded by "harder" evidence that the immune and neuroendocrine systems are in fact in close and bi-directional communication and, indeed, "talk" to each other all the time. A short list of discoveries early in the second wave includes the following: demonstration of direct microanatomical contacts between the nervous and the immune systems; discovery that anatomical lesions in or the electrical stimulation of parts of

Different parts of your brain share information and organize plans for action through a code system that involves both chemistry and electricity. Chemicals called neurotransmitters are emptied from tiny sacs into the space between nerve cells. These chemicals cross that space and bind to receptors on other nerve cells. The binding process triggers an electrical stimulus in the receiving cells, that starts the whole process of chemical release all over again.



When a foreign toxin or bacteria, called an antigen, enters the body, immune system cells race to the site of invasion. These cells are called lymphocytes (T and B cells) and macrophages. Receptors on the surfaces of these cells recognize and bind to the invader. The binding process triggers the production of chemical signals called interleukins. Interleukins allow immune cells to mature, communicate with each other, and to make antibodies and other substances that remove the invader.



At the same time that interleukins (sometimes called lymphokines and monokines) allow immune cells to signal one another, they also allow immune cells to signal the brain—and vice versa.

the brain influence antibody production in the spleen and lymph nodes; identification of receptor sites for neuroendocrine hormones and neurotransmitters on cells of the immune system. The "clincher" was the repeated proof in several different animal models that interruptions of these communications on a genetic, surgical, or pharmacological basis, lead to increased susceptibility to inflammatory diseases like arthritis. The converse is now also being shown, that too much responsiveness of these systems leads to enhanced susceptibility to infection. Now it is certain that particular molecules of the immune system (cytokines or interleukins) signal areas of the brain directly as well as exert influences on peripheral parts of the nervous system such as the vagus nerve. This rigorously demonstrated "cross-talk" between the immune and neuroendocrine systems has won over neuroscientists and gained converts among the immunologists themselves. Even more important, it provides the scientific basis for understanding—at long last—how emotions can in fact influence the onset, course, and remission of disease.

Two very different signs of enthusiasm and "arrival" already mark the 1990s: the inclusion of an entry on "Neuroendocrine Regulation of Immunity" in the 1992 *Encyclopedia of Immunology* and the featuring of psychoneuroimmunolgy as a central theme in Bill Moyers's 1993 best sell-

er, *Healing and the Mind*.[86] The first indicated the acceptance of the new field within the mainstream of previously resistant immunology and the second demonstrated popular fascination with the emerging inter-discipline. Moyers and many of his readers seized upon the new field as seeming to validate long-suspected but frequently denied connections between emotions and disease. A spate of high-level international scientific conferences marked by unusual energy and bold proclamations have added to the sense of excitement. The proceedings of one of these was published in 1994 as volume three of the "Hans Selye Symposia on Neuroendocrinology and Stress." The editors of the Selye volume capture the current mood:

> *The interaction of the nervous, endocrine and immune systems is only now being considered seriously. This field represents a novel, multidisciplinary approach in Biological Sciences. Even the name of the field has not been settled as yet and there are debates going on with regards to the proper term. . . . Modern science is equipped with powerful research tools which make it feasible to advance quickly in this complex multidisciplinary field, with the aim of understanding the whole organism, rather than trying to analyze restricted areas. The developments are spectacular, indeed, and the new insights gained . . . have already advanced our understanding of certain human diseases, such as autoimmune disease, inflammatory diseases, nervous and endocrine abnormalities and the influence of behavioral factors and of aging on the immune response and disease. We sincerely hope this volume will contribute to the understanding and acceptance of this brave new area of scientific enquiry.*

It may be that this "brave new area" will finally validate long held beliefs about emotions and disease that we in the West have been grappling with for at least two millennia.

Notes

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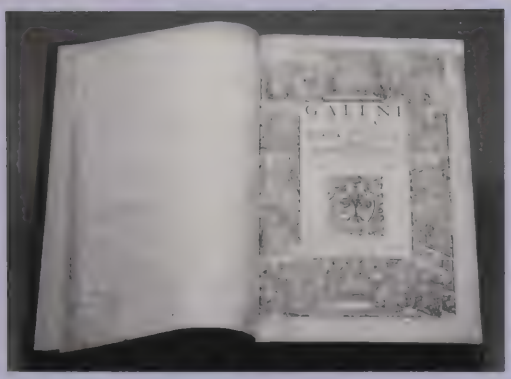
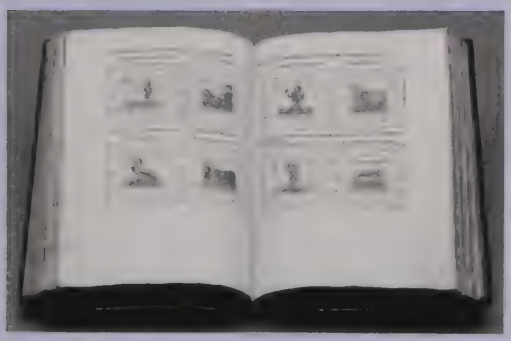
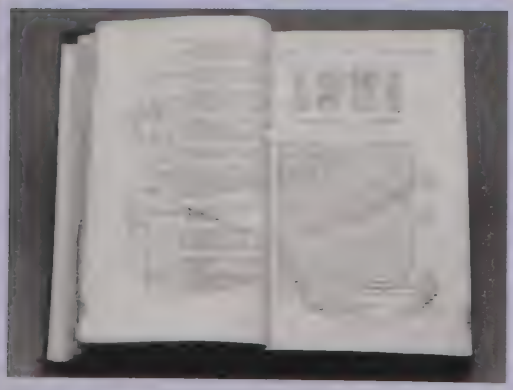


Galen, **Opera ex Sexta Juntarum Editione,** Venice, 1586



Johann Engel (1463–1512), **Astrolabium Planum in Tabulis Ascendens,** Augsburg, 1488



Robert Burton (1577–1640), **The Anatomy of Melancholy,** Oxford, 1632

Checklist for *Emotions and Disease*

In the list that follows, classmarks (call numbers) have been provided only for items from the collections of the National Library of Medicine. All measurements, when available, are given in centimeters unless otherwise noted.

The Balance of Passions

Walther Ryff (d. 1548), *Spiegel und Regiment der Gesundheyt,* Frankfurt, 1555. Graphic: Photographic reproduction of woodcut illustration. (illustrated page viii)

A Long Tradition

Johannes de Ketham (fl. 1455–1470), *Fasciculus Medicinae,* Vienna, 1495. Book: 31 (h) x 43 (open width) WZ240 K43f 1495. (illustrated page 2)

Description of the Humoral system. Graphic: Photographic reproduction of illustration with English translation of the original Latin text. Based on an original illustration in *Fasciculus Medicinae.* (illustrated page 2)

Hippocrates (ca. 460 B.C.–ca. 370 B.C.), *Hippokratous . . . Iatrike,* Basel, 1543. Book: 15 (h) x 21 (open width). WZ240 H667 1543. (illustrated page 2)

Galen (131–201), *Opera ex Sexta Juntarum Editione,* Venice, 1586. Book: 36.5 (h) x 48.5 (open width). WZ 240 G153L 1586 v. 1. (illustrated page 52)

Galen (131–201), *Opera ex Sexta Juntarum Editione,* Venice, 1586. Graphic: Photographic reproduction of illustration of a lovesick maiden taken from title page illustration. (illustrated page 3)

Johann Engel (1463–1512), *Astrolabium Planum in Tabulis Ascendens,* Augsburg, 1488, copy 1. Book: 25.5 (h) x 37.5 (open width). WZ230 A585a 1488 c.1. (illustrated page 52)

Gregor Reisch (d. 1525), *Margarita Philosophica cum Additionibus Novis,* Basel, 1517. Book: 21.5 (h) x 36 (open width). WZ240 R375m 1517. (illustrated page 4)

Gregor Reisch (d. 1525), *Margarita Philosophica cum Additionibus Novis,* Basel, 1517. Graphic: Photographic reproduction of illustration of profile of head. (image unavailable for catalogue)

Moses Maimonides (1135–1204), *Tractatus Rabbi Moysi de Regimine Sanitatis ad Soldanum Regem*, Augsburg, 1518. Book: 20 (h) x 28 (open width). WZ240 M911tL 1518. (illustrated page 4)

Justus Cortnummius (ca. 1624–1675 m.), *De Morbo Attonito Liber Unus*, Leipzig, 1677. Book: 21 (h) x 33 (open width). WZ250 C8298dm 1677. (illustrated page 3)

Ambroise Paré (1510?–1590), *The Workes*, London, 1649. Book: 33 (h) x 45.5 (open width). WZ250 fP227E 1649. (illustrated page 5)

Honoré Daumier (1808–1879), *Bobonne, Bobonne, tu me ferais un monstre comme ça, ne le regarde pas tant!*, 1860s. Lithograph: 33 (h) x 25 (w). (illustrated page 6)

Robert Burton (1577–1640), *The Anatomy of Melancholy*, Oxford: Printed for Henry Cripps, 1632. Book: 29 (h) x 37.5 (open width). WZ250 B9745a 1632. (illustrated page 52)

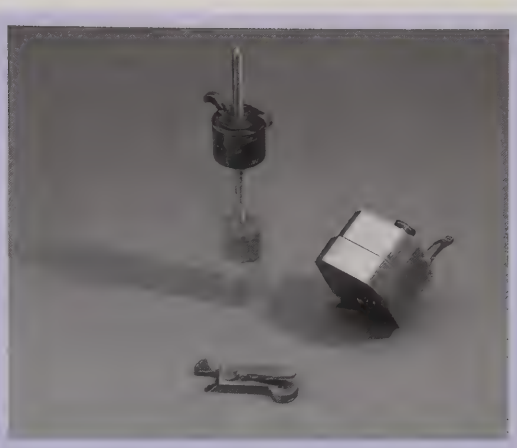
William Falconer (1744–1824), *A Dissertation on the Influence of the Passions Upon the Disorders of the Body*, London, 1788. Book: 20.5 (h) x 27 (open width). WZ260 F179d 1788. (illustrated page 6)

Bloodletting lancet, 19th century. Lancet: 1/2" (h) x 1" x (w) 2" (l). Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 53)

Scarificator, 19th century. Scarificator: 2" (h) x 1" (w) x 2" (l). Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 53)

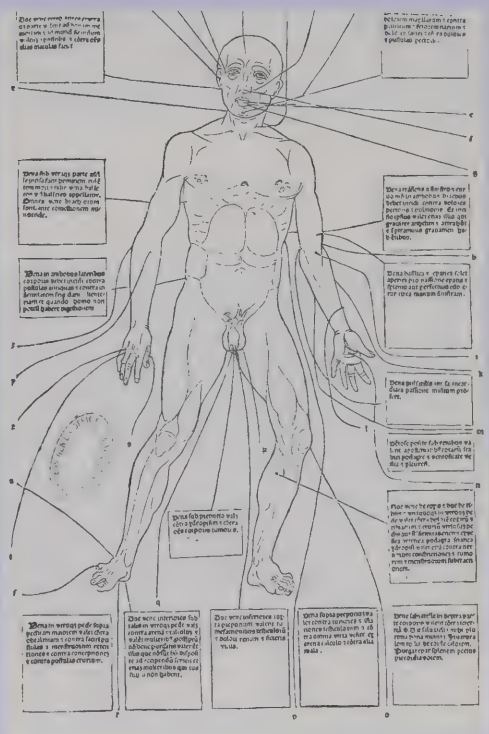
Artificial leech, 1879. Leech: 5" (h) x 1" (dia). Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 53)

Johannes de Ketham (fl. 1455–1470), *Fasciculus Medicinae*, Vienna, 1495. Graphic: Photographic reproduction of illustration of bloodletting sites. (illustrated page 53)



These mechanical bloodletting devices were used by physicians in the nineteenth century, an indication of the long persistence of humoral practice in medicine, even after the partial eclipse of humoral theory in the seventeenth century.

Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C.



Johannes de Ketham (fl. 1455–1470), **Fasciculus Medicinae,** Vienna, 1495.

Joseph Woodward used this microscope in his pioneering work as a microscopist. The mirror reflected the light from a window through the microscope and onto a photoplate, thereby allowing Woodward—or other scientists—to photographically capture certain features of cells.

Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C.

This autopsy kit from ca. 1845 shows instruments more refined than those of the sixteenth century, although their basic design is not much altered.

Courtesy Historical Collections, The National Museum of Medical History, Armed Forces Institute of Pathology, Washington, D.C.

The Challenge of Anatomy

Andreas Vesalius (1514–1564), *De Humani Corporis Fabrica*, Venice, 1568. Book: 32.5 (h) x 45 (open width). WZ240 fV575d 1568. (illustrated page 7)

Andreas Vesalius (1514–1564), *De Humani Corporis Fabrica*, Venice, 1568. Graphic: Photographic reproduction of illustration of autopsy/dissection tools. (illustrated page 7)

Thomas Willis (1621–1675), *The Remaining Medical Works of Thomas Willis*, London, 1679. Book: 34 (h) x 46.5 (open width). WZ250 fW35phE 1679a. (illustrated page 8)

Rudolf Virchow (1821–1902), *Die Cellularpathologie in ihrer Begründung auf Physiologische und Pathologische Gewebelehre*, Berlin, 1858. Book: 22 (h) x 29.5 (open width). QSA V813c 1858. (illustrated page 9)

Rudolph L.K. Virchow. Photograph: 16.5 (h) x 11 (w). (illustrated page 9)

René Théophile Hyacinthe Laënnec (1781–1826), *De l'Auscultation Médiate, ou, Traité du Diagnostic des Maladies des Poumons et du Coeur (On Mediate Auscultation, or, Treatise on the Diagnosis of the Diseases of the Lungs and Heart)*, Paris, 1819. Book: 21 (h) x 26 (open width with illustration). WF L158de. (illustrated page 8)

Postcard of *Laënnec, A l'Hopital Necker, Ausculte Un Phtisique*, original painting by Théobald Chartran (1849–1907). Postcard: 15.7 (h) x 12 (w). (illustrated page 8)

Laënnec-style stethoscope. Stethoscope: 10" (l) x 1.5" (dia). Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 8)

Microscope, 1864. 11" (h) x 16" (l) x 9.5" (d). Courtesy Historical Collections, National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 54)

Alexandar Levy, *Woodward Working in the Laboratory*, ca. 1952. Graphic: Photographic reproduction of illustration. (image unavailable for catalogue)

Autopsy/dissection kit, ca. 1845. 1" (h) x 3" (w) x 7" (l) closed. Courtesy Historical Collections, National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 54)

Edouard Hamman (1819–1888), *Andreas Vesalius*, ca. 1848. Lithograph: 31.2 (h) 40.2 (w). (illustrated page 7)

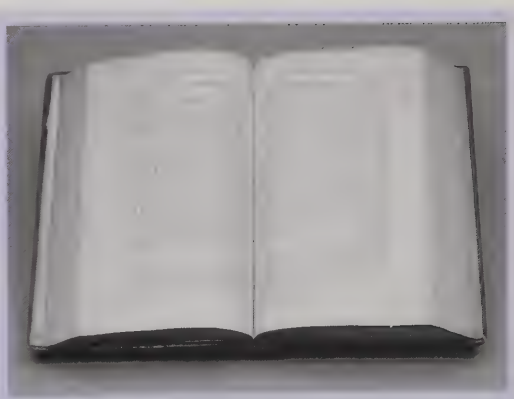
Lucia Rosetti, *The University of Padua, An Outline of Its History*, Trieste, 1983. Courtesy Esther Sternberg. (image unavailable for catalogue)

The Compromise

William Cullen (1710–1790), *First Lines of the Practice of Physic*, Edinburgh, 1784. WZ260 C967f 1784. (illustrated page 10)

Roberty Whytt (1714–1766), *Observations on the Nature, Causes, and Cure of Those Disorders Which Have Been Commonly Called Nervous, Hypochondriac, or Hysteric*, Edinburgh, 1765. Book: 20.5 (h) x 28 (open width). (illustrated page 55)

Austin Flint (1812–1886), *A Treatise on the Principles and Practice of Medicine*, Philadelphia, 1868. WB F623t 1868. (illustrated page 11)



Robert Whytt (1714–1766), **Observations on the Nature, Causes, and Cure of Those Disorders Which Have Been Commonly Called Nervous, Hypochondriac, or Hysteric**, Edinburgh, 1765

Psychosomatic Medicine: The "Puzzling Leap"

André Brouillet, *Une Leçon Clinique à la Salpêtrière*, 1887. Graphic: Photographic reproduction of painting. B4519. (illustrated page 12)

Camera, ca. 1900. Camera: 16" (h) x 16" (w) x 42" (l). Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 14)

Désiré-Magloire Bourneville (b. 1840) and Paul Regnard, *Iconographie Photographique de la Salpêtrière*, Paris, 1877–1880. Graphics: Two Photographic reproductions of two patients with hysteria. (illustrated page 14)

Honoré Daumier (1808–1879), *Le malade imaginaire*, 1860s. Lithograph. Courtesy Penny Herscovitch. (illustrated page 13)

Josef Breuer (1842–1925) and Sigmund Freud (1856–1939), *Studies on Hysteria*, New York, 1957. WM173 B846s 1957. (illustrated page 15)

Berggasse 19, Sigmund Freud's Home and Office, Vienna 1938, The Photographs of Edmund Engelman, Chicago, 1976. CC2656. (image unavailable for catalogue)

Sidney Chafetz, *Portrait of Sigmund Freud*, 1964. Etching: 69 (h) x 56 (w). (illustrated page 15)

H. Flanders Dunbar (1902–1959), *Emotions and Bodily Changes: A Survey of Literature on Psychomatic Interrelationships, 1910–1933*, New York, 1935. Book: 24.5 (h) x 35.5 (open width). WM90 D898e 1935 (illustrated page 18)

Psychosomatic Medicine, September–October 1959. W1 P582. (illustrated page 18)

Smith Ely Jelliffe (1866–1959), "Psychopathology and Organic Disease," *Sketches in Psychosomatic Medicine*, New York, 1939. W1 NE211 no.65 1939. (image unavailable for catalogue)

Georg Groddeck (1866–1934), *The Book of the It*, New York, 1928. Book: 23 (h) x 32.5 (open width). W1 NE211 v. 49. (illustrated page 17)

Franz Alexander (1891–1964), *Psychosomatic Medicine*, New York, 1950. Book: 22 (h) x 31.5 (open width). WM90 A375p 1950. (image unavailable for catalogue)

Franz Alexander (1891–1964), *Psychosomatic Medicine*, New York, 1950. Graphic: Photographic reproduction of schematic representation of specificity in the etiology of the peptic ulcer. (illustrated page 19)

Helen Lundeberg (1908–), *Double Portrait of the Artist in Time*, 1935. Graphic: Photographic reproduction of oil painting. Courtesy National Museum of American Art, Smithsonian Institution, Washington, D.C. (illustrated page 56)

Roy Grinker (1900–1993) and John P. Spiegel, *War Neuroses in North Africa: The Tunisian Campaign (January–May, 1943).* Prepared and distributed for the Air Surgeon, Army Air Forces by the Josiah Macy, Jr. Foundation, New York, September 1943. Book: 23 (h) x 15 (w). WM184 G867w 1943. (illustrated page 18)

Roy Grinker (1900–1993) and John P. Spiegel, *Men Under Stress*, Philadelphia, 1945. Book: 33 (h) x 23 (w). WM184 G867m 1945. (illustrated page 18)

Thomas W. Salmon (1876–1927), *The Care and Treatment of Mental Diseases and War Neuroses ("Shell Shock") in the British Army*, War Work Committee of the National Committee for Mental Hygiene, New York, 1917. Book: 24.5 (h) x 46.5 (open width with illustration). US 629 S172c 1917. (illustrated page 16)

Double Portrait of the Artist in Time
Helen Lundeberg

Psychosomatic medicine traced the diseases suffered as an adult back to the developmental dramas and traumas of early childhood.

Courtesy National Museum of American Art, Smithsonian Institution, Washington, D.C

Frank Loesser (1910–1969), "Adelaide's Lament," *Guys and Dolls*, 1950. © 1950, 1978 Frank Music Corporation. Sheet music and lyrics. Donated by Lou Storey. (image unavailable for catalogue)

Self-Healing, Patents, and Placebos,

Pharmaceutical Era, February 1889. Graphic: Photographic reproduction of illustration of pharmacy designed and built by C.H. Bangs. (illustrated page 21)

Pharmacy Bottle. Bottle: 26" (h) x 6" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 57)

Benjamin Rush (1746–1813), *An Inquiry into the Effects of Ardent Spirits upon the Human Body and Mind, with an Account of the Means of Preventing, and of the Remedies for Curing Them*, New York, 1811. Book: 17 (h) x 21.5 (open width). WZ270 R952i 1811. (illustrated page 21)

Albert Vernon, *Correspondence Course of Instruction in the Science of Psychratism or Prowess of the Human Mind*, Rochester, New York, The Vernon Academy of Mental Sciences and The Vernon Sanatorium, 1900. Book: 17.5 (h) x 53.5 (open width). BF V539c 1900. (illustrated page 57)

Julia Anderson Root, *Healing Power of Mind: A Treatise on Mind-Cure, with Original Views on the Subject and Complete Instructions for Practice and Self-Treatment*, Peoria, Illinois, 1886. Book: 20.5 (h) x 32.5 (w). WM R806h 1886. (illustrated page 22)

Notman, *William James*, Graphic: Photographic reproduction of a photograph. B15230. (illustrated page 22)

Mirror with gilt frame (with Emile Coué quote), ca. 1920. Courtesy Elizabeth Fee. (image not available for catalogue)

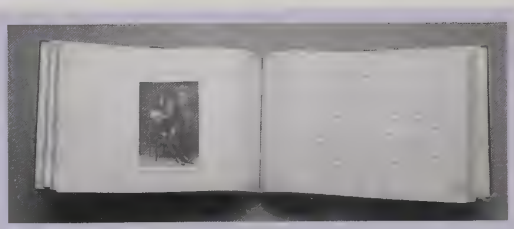
Charles Fremont Winbigler (1857–1925), *How to Heal and Help One's Self or a New Outlook on Life*, Los Angeles, 1916. Book: 20 (h) x 14 (w). QT180 W758h 1916. (illustrated page 57)

John Kearsley Mitchell (1859–1917), *Self Help for Nervous Women: Familiar Talks on Economy in Nervous Expenditure*, Philadelphia, 1909. Book: 20 (h) x 14 (w).WM M675s 1909. (illustrated page 57)

"Laughter is the Best Medicine," *Reader's Digest*, April 1958. Magazine: 7" (h) x 10" (w). Courtesy Ghilta Sternberg. (illustrated page 23)

Pharmacy Bottle.

Courtesy Elaine and Arthur Shapiro.



Albert Vernon, **Correspondence Course of Instruction in the Science of Psychratism or Prowess of the Human Mind,** Rochester, New York, The Vernon Academy of Mental Sciences and The Vernon Sanatorium, 1900

Charles Fremont Winbigler (1857–1925), **How to Heal and Help One's Self or a New Outlook on Life,** Los Angeles, 1916
John Kearsley Mitchell (1859–1917), **Self Help for Nervous Women: Familiar Talks on Economy in Nervous Expenditure,** Philadelphia, 1909

Dale Carnegie (1888–1955), *How to Stop Worrying and Start Living*, New York, 1985, © 1944. Book: 6" (h) x 4" (w). (image unavailable for catalogue)

Thomas A. Harris (1913–), *I'm Okay—You're OK*, New York, 1973, ©1967. Book: 7" (h) x 4" (w). (illustrated page 23)

Norman Vincent Peale (1889–1994), *The Power of Positive Thinking*, New York, 1992, ©1952. Book: 7" (h) x 4" (w). (illustrated page 23)

Perkins's Metallic Tractors, late 18th century. Tractors: 3" (l) x 1/2" (w). Courtesy Historical Collections, The National Museum of Health and Medicine, Armed Forces Institute of Pathology, Washington, D.C. (illustrated page 25)

John Haygarth, *Of the Imagination as a Cause and as a Cure of Disorders of the Body; Exemplified by Fictitious Tractors, and Epidemical Convulsions*, Bath, 1800. Book: 21.5 (h) x 27.5 (w). WZ260 H4210 1800. (illustrated page 25)

Benjamin Douglas Perkins (1774–1810), *The Family Remedy; or, Perkins's Patent Metallic Tractors, For the Relief of Topical Disease of the Human Body; And of Horses*, 1800. Pamphlet: 22.5 (h) x 14.5 (w). WBC P448c 1801. (illustrated page 25)

Unicorn horn. Horn: 73" (h) x 4" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Kickapoo Oil: Relief from Aches and Pains. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Nerve & Bone Liniment. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Dr. Pierce's Favorite Prescription. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Hood's Sarsaparilla, Gentian and Bitter Orange Compound. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Bliss Native Balsam. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Swamp Root. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Milks Emulsion Natures Remedy. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Erso Anti-Bilious Bitters. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Pastor Koenig's Nervine for Nervous Aliments. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Goldine Tonic and Nervine. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Ads Compound Syrup Hypophosphites Clear. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Dr. Pierce's Golden Medical Discovery. Courtesy Elaine and Arthur Shapiro. (image unavailable for catalogue)

Powered unicorn horn. Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Four Batteries. Batteries: 1" (dia) to 1" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 25)

Humphreys' Remedies sign. Sign: 16" (h) x 12" (w). Courtesy Elaine and Arthur Shapiro. (illustrated page 24)

Warner's Safe Cure Almanac and Book of Handy Information 1895. Buffalo, New York. Book: 22 (h) x 15.5 (w). W6 P3 no. 7475. (illustrated page 24)

Portrait of William Osler. Graphic: Photographic reproduction of painting. 20142. (illustrated page 26)

Milk Sugar. Bottle: 5" (h) x 2" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 28)

Antilirium Placebo. Bottle: 4" (h) x 2" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 28)

Cebocap No. 1. Bottle 2" (h) x 1" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 28)

Cebocap No. 2. Bottle 2" (h) x 1" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 28)

Cebocap No. 3. Bottle 2" (h) x 1" (dia). Courtesy Elaine and Arthur Shapiro. (illustrated page 28)

Nardil Placebo. Courtesy Elaine and Arthur Shapiro. (illustrated page 29)

Placebo for Elavil HC1. Courtesy Elaine and Arthur Shapiro. (illustrated page 29)

Placebo for Stelazine. Courtesy Elaine and Arthur Shapiro. (illustrated page 29)

Placebo for Valium. Courtesy Elaine and Arthur Shapiro. (illustrated page 29)

Jon D. Levine, Newton C. Gordon, Howard L. Fields, "The Mechanism of Placebo Analgesia," *The Lancet*, September 23, 1978. Book: 28 (h) x 38 (open width). W1 LA453. (illustrated page 29)

"Pain Pathways." Graphic: Photographic reproduction of illustration. Courtesy Alfred Mansour, Mental Health Research Institute, University of Michigan. (image unavailable for catalogue)

Stress and Deprivation

Peter Gridley, *Long Island Expressway*. Graphic: Photographic reproduction of photograph. (illustrated page 30)

Chris Todd, "Noise Pollution." Audio recording.

Walter Bradford Cannon. Graphic: Photographic reproduction of photograph. B30295. (illustrated page 32)

Walter Bradford Cannon (1871–1945), *Bodily Changes in Pain, Hunger, Fear and Rage: An Account of Recent Researches into the Functions of Emotional Excitement*, New York, 1915. BF511 C266b 1915. (illustrated page 32)

Walter Bradford Cannon (1871–1945), *The Wisdom of the Body*, New York, 1939. QT104 C226W 1939. (image not available for catalogue)

Hans Selye (1907–1982), *The Physiology and Pathology of Exposure to Stress*, Montreal, 1950. Book: 24.8 (h) x 39.5 (open width). QZ140 S469p 1950. (illustrated page 33)

American Journal of Nursing, March 1965. W1 AM495. (illustrated page 34)

Reader's Digest, February 1957. Magazine: 19 (h) x 27 (open width). Courtesy Ghilta Sternberg. (illustrated page 33)

Howard Taft Lorenz, *Dismissal (or) Pink Slip*, 1940. Graphic: Photographic reproduction of oil painting. Courtesy National Museum of American Art, Smithsonian Institution, transfer from Museum of Modern Art. (illustrated page 35)

Excerpts from *Monica Study*, 1950s. Video. Courtesy Dr. George Engel.

Monica, 1950s. Graphic: Photographic reproduction of six original photographs of Monica. Courtesy Dr. George Engel. (illustrated page 34)

2/26/54 Applegate, Histamine laboratory "flowsheets." Graphic: Photographic reproduction of original laboratory notes. Courtesy Dr. George Engel. (illustrated page 34)

B. Kent Houston and C.R. Snyder, editors, *Type A Behavior Pattern: Research, Theory, and Intervention*, New York, 1988. Book: 24 (h) x 36 (w). WG300 T991 1988. (illustrated page 35)

Robert Dantzer, *The Psychomatic Delusion*, New York, 1993. 1993 A261. (image unavailable for catalogue)

Defuse Stress, Health Dynamics Poster Program. ©1988 Clement Communications, Inc. Poster: 56 (h) x 43.2 (w). A25395 (image unavailable for catalogue)

Kai T. Erickson, *Everything in Its Path*, New York, 1976. Donated by Lou Storey. (image unavailable for catalogue)

Barry J. Marshall, Richard W. McCallum, Richard L. Guerrant, editors, *Helicobacter Pylori in Peptic Ulceration and Gastritis*, Boston, 1991. WI310 H475 1991. (image unavailable for catalogue)

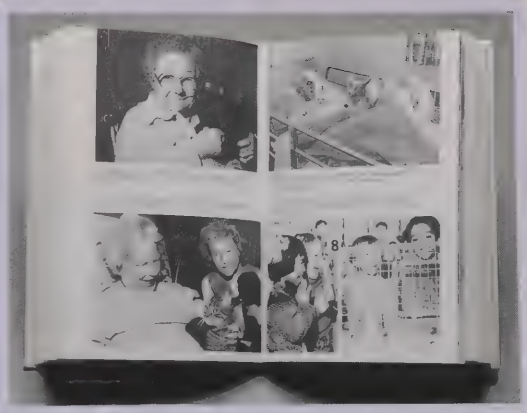
Scott Adams, *Dilbert*, September 15, 1996. Graphic: Photographic reproduction of cartoon. © 1996 United Feature Syndicate, Inc. (illustrated page 37)

Volvo Assembly Line, Sweden, ca. 1987. Graphic: Two photographic reproductions of the assembly line. Courtesy Volvo Truck Corporation, Powertrain Division, Skövde, Sweden. (illustrated page 37)

Saratoga Spa, N.Y., ca. 1950s. Postcard: 3" (h) x 5". Courtesy Ghilta Sternberg. (illustrated page 36)

Betty White with Thomas J. Watson, *Betty White's Pet-Love: How Pets Take Care of Us*, New York, 1983. Book: 21.5 (h) x 30 (open width). DD8254. (illustrated page 61)

Cindy Ruskin, photographs by Matt Herron, *The Quilt: Stories from the NAMES Project*, New York, 1988. Courtesy Nola Heffner. (image unavailable for catalogue)



Betty White with Thomas J. Watson, **Betty White's Pet-Love: How Pets Take Care of Us,** New York, 1983

Some hospitals, hospices and nursing homes have discovered that patients feel calmer and less depressed in the presence of a loving, furry friend—some may even become more stable physiologically or recover more quickly from their illness as a result of their involvement in "pet therapy."

Photograph credits (l to r): Courtesy of People-Pet Partnership Program; Flossie Stowell; Courtesy of People-Pet Partnership Program; Courtesy of People-Pet Partnership Program. Used by permission of William Morrow & Co., Inc.

Frontiers of the Mind
How Emotions Matter

Positron Emission Tomography (PET scanner). Graphic: Photographic reproduction. Courtesy GE Medical Systems. (illustrated page 38)

Emotions and Disease: The Delicate Balance, 1996. Video. Produced by the National Library of Medicine with Multimedia Software Inc. for the exhibition *Emotions and Disease*.

Tiger in the wild (including close-up). Graphic: Photographic reproduction from *Emotions and Disease* video. Courtesy National Geographic Television. (image unavailable for catalogue)

Fear-response system. Graphic: Photographic reproduction of *Emotions and Disease* video illustration. Illustrated by Bob Howard Computer Graphics. (image unavailable for catalogue)

Neurotransmitters. Graphic: Photographic reproduction from *Emotions and Disease* video. Illustrated by Bob Howard Computer Graphics. (illustrated page 43)

Optical imaging camera. Camera: 14.4 (h) x 13.21 (w) x 21.9 (d). Courtesy Photometrics, Ltd. (illustrated page 42)

Image created by optical imaging camera. Graphic: Photographic reproduction of imaging camera output. Courtesy Ehud Kaplan and Richard Everson, Mount Sinai School of Medicine, New York. (illustrated page 42)

PET scans of brain activity during transient sadness and happiness. Graphic: Photographic reproductions of PET scans. Courtesy Mark S. George, Medical University of South Carolina, Charleston. (illustrated page 40)

PET scans of brain activity of people who have been asked to look at, listen to, think about or speak a word. Graphic: Photographic reproduction of PET scans. Courtesy Marcus E. Raichle, Washington University, St. Louis, Missouri. (illustrated page 40)

Functional magnetic resonance image (fMRI) of brain activity of a person looking at faces. Graphic: Photographic reproduction of fMRI. Courtesy V.P. Clark, K. Keil, J. Ma. Maisog, S. Courtney, L.G. Ungerleider, and J.V. Haxby, National Institute of Mental Health. (illustrated page 41)

Activation of T-cells. Graphic: Photographic reproduction of illustration. (illustrated page 44)

Molecular structure of interleukin-1. Graphic: Photographic reproduction of illustration. Courtesy: Angela Gronenborn, National Institute of Diabetes and Digestive and Kidney Diseases. Illustrated by Bob Howard Computer Graphics. (image unavailable for catalogue)

The Immune System and the Nervous System. Graphic: Photographic reproduction of illustration. (illustrated page 44)

Physician examining a sick child. Graphic: Photographic reproduction. Courtesy National Institute of Allergy and Infectious Diseases. ((image not available for catalogue)

Computerized photomicrographic microscope. Graphic: Photographic reproduction. Courtesy Leica Inc., Deerfield, Illinois. (illustrated page 42)

In situ hybridization. Graphic: Photographic reproduction of imaging microscope output. Courtesy Miles A. Herkenham, National Institute of Mental Health. (illustrated page 42)

Normal circulating human blood. Graphic: Photographic reproduction of scanning electron microscope output. Courtesy Bruce Wetzel and Harry Schaeffer, National Cancer Institute. (illustrated page 42)

Researcher and DNA sequencing gel. Graphic: Photographic reproduction. Courtesy National Institute of Allergy and Infectious Disease. ((image not available for catalogue)

A Dynamic Balance

Overactive hypothalamus. Graphic: Photographic reproduction of *Emotions and Disease* video illustration. Illustrated by Bob Howard Computer Graphics. (image not available for catalogue)

An overactive amygdala. Graphic: Photographic reproduction of *Emotions and Disease* video illustration. Illustrated by Bob Howard Computer Graphics. (illustrated page 40)

Interruption of the brain/immune system communication. Graphic: Photographic reproduction of *Emotions and Disease* video illustration. Illustrated by Bob Howard Computer Graphics. (image not available for catalogue)

Immune system stuck in the on position. Graphic: Photographic reproduction of *Emotions and Disease* video illustration. Illustrated by Bob Howard Computer Graphics. (image not available for catalogue)

Imbalance in the chemical transmission between neurons. Photographic reproduction of *Emotions and Disease* video illustration. Illustrated by Bob Howard Computer Graphics. (image not available for catalogue)

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Let There Be Light video excerpts

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Brian Matthews
National Library of Medicine
Editor

Open captions and laser disk provided by Audiovisual Program Development Branch, Lister Hill National Center for Biomedical Communications, NLM

Monica Story video excerpts

Video and Images

Courtesy Dr. George L. Engel
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Emotions and Disease: A Delicate Balance video

Video and Images

The Arthritis Foundation
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